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Business

By Jon Christian
GLOBE CORRESPONDENT

In an operating theater deep in Boston Children's Hospital, surrounded by state-of-the-art medical equipment, a surgical team is on the brink of losing a young patient. Their goal was to locate and repair a perforation in the bowel, but something's gone wrong: The liver is bleeding uncontrollably, and if they can't staunch the source, the patient's chances are grim.

Someone calls a code blue, indicating cardiac arrest, and a crash cart appears as a heart monitor reaches a fever pitch. And then, just as suddenly, Dr. Peter Weinstock interrupts and a startling calm replaces the crisis atmosphere.

"OK, guys, we're going to pause right now," Weinstock called out to the surgical team. "We're going to head back to do our last debriefing."

Weinstock is director of Boston Children Hospital's Simulator Program, and his current "baby" on the. operating table is a sophisticated medical mannequin that provides surgical teams with an immersive training environment.

The child-sized mannequin is named Surgical Sam. Under its skin, which surgeons cut into with real scalpels, are facsimile bones, organs, and fluids made from plastic and other synthetic materials that approximate human tissues and liquids.

Like a real child, Sam breathes and has a heartbeat, and, if you nick an artery, bleeds synthetic red blood.

During a simulated procedure, Weinstock or another facilitator improvises challenges or unexpected events that surgical teams would face during a real operation, murmuring directions through a radio headset to technicians who manipulate Sam's condition and vital signs from a nearby computer.

The big-picture goal of the Surgical Sam program, Weinstock said, is to create a non-judgmental environment where members of an operating team can improve their communication during real life-threatening situations.

To date, the hospital has used Surgical Sam to train several hundred surgeons, nurses, anesthesiologists, and other clinicians.

"The reason planes crash is not because people don't know how to fly planes," said Weinstock. "The reason planes crash is because pilots don't talk to each other. It's much easier for clinicians to talk about technical work than about why they don't communicate well."

Founded in 2001, the Simulator Program has long orchestrated various test-runs, from clinical contact with patients, to infectious-disease outbreak scenarios. When Weinstock became director in 2008, he became interested in rehearsing surgical procedures as well.

"These are not novice surgeons," Weinstock said. "The task ahead of us was to engage native teams in their native environments. So the trainers had to rise to the level of the practitioners."

In 2010, Weinstock reached out to the Chamberlain Group, a Great Barrington company that makes models and facsimile body parts for medical training.

The Chamberlain Group itself has an unusual history. Lisa and Eric Chamberlain started in the movie business, creating special effects and opening titles for such films as the original "Ghostbusters" in 1984. They also worked on the "bullet time" sequence in the 1999 film "The Matrix," designing a customized camera rig.

Soon after "The Matrix," however, the Chamberlains and a group of collaborators made a career shift, using their special-effects skills to design high-quality medical replicas. They set up shop in Great Barrington and began producing models for such clients as Brigham & Women's Hospital, Johns Hopkins, and Covidien.

"Because we had this funky background in the movie business, we were able to move in the direction of making physical models that would replicate the physical experience of surgery," said Lisa Chamberlain.

After seeing a presentation by Lisa Chamberlain, Weinstock got the company to create the mannequin that would become Surgical Sam. The body holds various modules of organs for different procedures — one for heart and lung operations and another for abdominal surgery, with more under development.

The Chamberlain Group modeled Sam's components digitally and used 3-D printers to produce casts that allowed the designers to experiment with plastics to approximate the textures of different types of tissue.

"We wanted it to be sufficiently lifelike and immersive in its use so that the clinician can suspend disbelief and get their heart rate going, but also creating it in a way that can be reproduced and proliferated," Lisa Chamberlain said.

The design process was highly iterative. One collaborator, Francis Fynn-Thompson, director of Boston Children's Hospital's lung- and heart-transplant programs, would receive a parcel of freshly molded organ systems from the Chamberlain Group. He would inspect each one closely, feeling its contours and sometimes cutting into it with a scalpel, then suggest ways to increase the realism of the next version.

"I'd evaluate the consistency, the shape, the feel," Fynn-Thompson said.

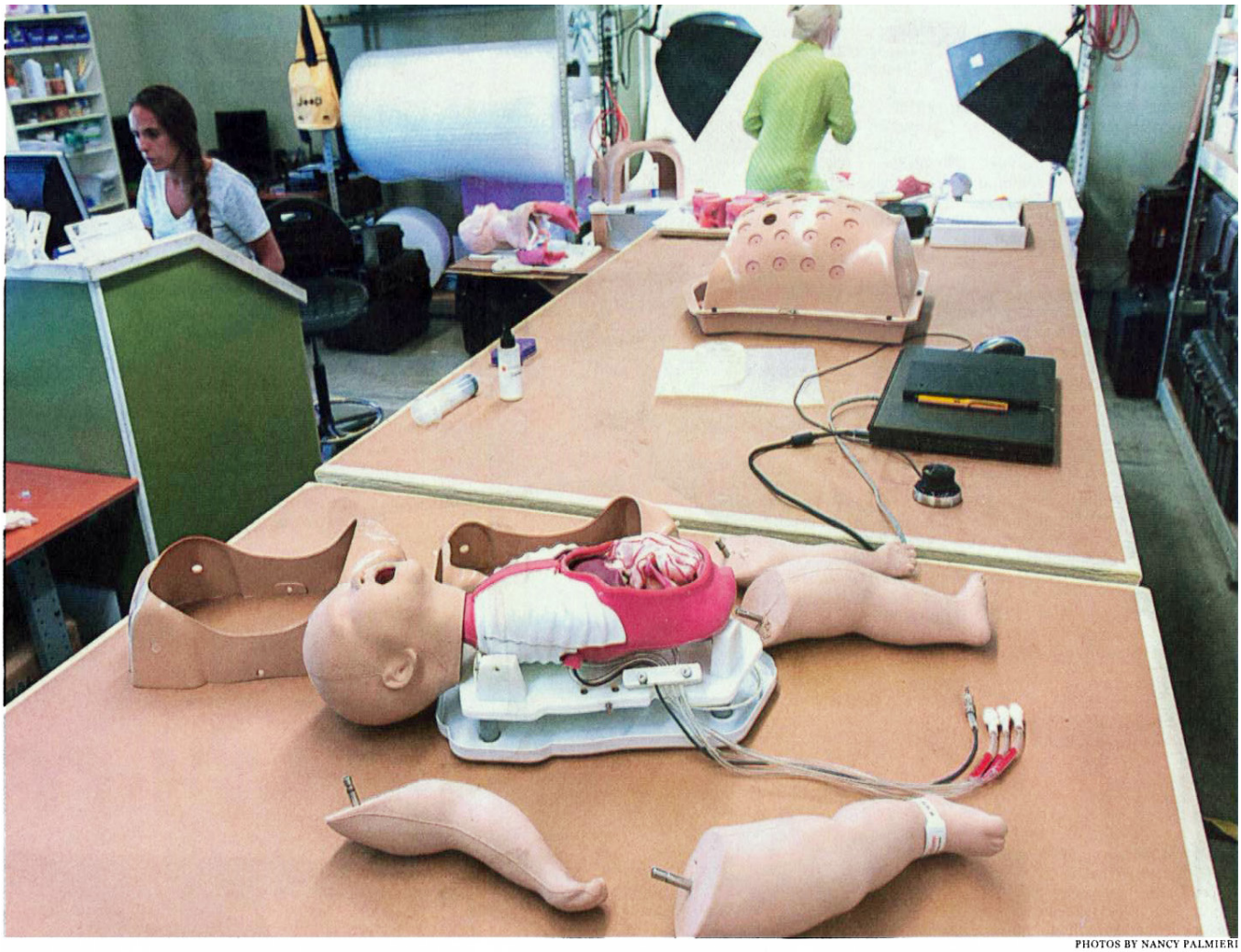
Crucially, procedures on Surgical Sam are interrupted by a facilitator, often Weinstock himself, who brings the surgical team to another room to discuss how they performed and communicated under pressure.

"Surgical Sam is a tool that helps us elicit authentic behaviors from our teams," said Christopher Rousin, director of academics and research at the Simulator Program. "These are world-class surgical teams, so we need something that's high-quality enough to elicit high-quality behaviors."

Back in the operating theater, after the procedure is over, a technician discards the blood-stained blue sheets, vacuums up spilled fluids with a suction hose, and peers knowingly into Sam's open chest cavity.

"Going to need new skin and bowels," she said, matter-of-factly.

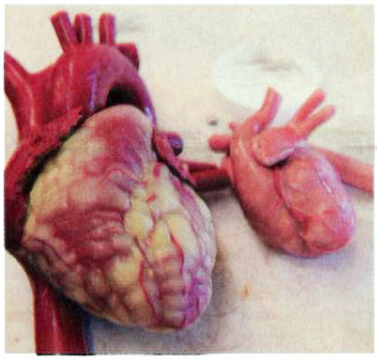
Jon Christian can be reached at jonathan.a.christian@gmail.com.



PHOTOS BY NANCY PALMIERI

BODY BUILDING

A mannequin that breathes, bleeds, and carries a heartbeat is helping to keep surgical teams at Children's Hospital at the top of their game



PAT GREENHOUSE/GLOBE STAFF

Employees of Chamberlain Group (top), including co-founder Lisa Chamberlain (left), produce realistic mannequins, like the one used for a recent mock procedure at Children's Hospital (above).