

The Evolving Role of Simulation in Teaching Surgery in Undergraduate Medical Education



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KEYWORDS

- Surgical simulation • Medical student • Education • Standardized patient
- Entrustable professional activity

KEY POINTS

- SBT has emerged as an effective training tool in undergraduate medical education (UME) in response to increasing volumes of knowledge, skills, and attitudes (KSA) that students must acquire and patient safety concerns resulting from medical students learning and practicing on actual patients.
- SBT is already used in select high-stakes assessments of medical students, such as the United States Medical Licensing Exam Step 2 Clinical Skills, and validity evidence for additional applications of SBT for formative and summative assessments is growing.
- Simulation has become the preferred method for teaching and training of several national medical student surgical education initiatives.

INTRODUCTION

Simulation-based training (SBT) has long been employed by surgeons to teach their craft to residents and students. For example, surgical educators have frequently incorporated basic technical skills task simulators and animate laboratories into the educational curricula of medical students to teach basic operative skills and procedures.¹ Over the last 10 years, however, they have made a concerted effort to develop organized SBT curricula with assessments to teach and evaluate the cognitive, technical, and decision-making skills of students to enhance education and patient care.² These changes in undergraduate medical education (UME) are an attempt to meet the evolving need for continued education of medical students under the current demands of time, medical knowledge, quality, and patient safety.^{2,3}

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This article discusses the demands and drivers on undergraduate surgical education, the history of SBT for students, types of simulators commonly used in current curricula, and 3 major national efforts incorporating SBT at the UME level:

1. The American College of Surgeons/Association for Surgical Education (ACS/ASE) medical student simulation-based surgical skills curriculum⁴
2. The American College of Surgeons/Association of Program Directors in Surgery/ Association for Surgical Education (ACS/APDS/ASE) resident preparatory curriculum⁵
3. The Association of American Medical Colleges (AAMC) core entrustable professional activities (EPAs) for medical students⁶

BRIEF HISTORY OF SIMULATION

SBT has been utilized for hundreds of years in both medical and surgical education.⁷ Recent efforts by surgical educators have focused on a systematic and concerted effort toward using such training to efficiently transfer information to and assess a surgical learner.⁸ Very early simulators in the 14th to 17th centuries were clay figurines used to teach acupuncture points and meridians. Later in the 18th century, life-sized wax human models, the forerunners of today's current plastic models, were used to teach anatomy. One of the earliest SBT curricula can be traced to 18th century Italy and the development of obstetric simulators to educate midwives in order to lower the incidence of birth mortality. Giovanni Antonio Galli, a surgeon in Bologna, designed a birthing simulator and required students to demonstrate the delivery of a child while blindfolded. Galli's development of an SBT curriculum thus incorporated key educational principles used today: performance of a needs assessment, matching the teaching method to the skill desired, and development of an assessment tool to verify learning. The idea of SBT for midwives was expanded nationally in France in 1759 to address the decline in the population of rural France. Louis XV commissioned Angelique Marguerite Le Boursier du Coudray to teach midwifery across France to save infant lives during birth. Simulation continued to be used within obstetrics but was not uniformly accepted as the standard. By the time of the Flexner report in the United States, obstetric simulators were more accepted, and several medical schools were condemned, because their obstetric simulators were in such disrepair.⁷

Interestingly, the first SBT specific to surgeons can be traced to Sushruta, an Indian scholar from approximately the fourth century to the sixth century BC. His Sanskrit-language text was translated in 1907 and contains descriptions and lessons for students to practice inserting their knives and tools into natural objects mimicking body parts. Students were also asked to practice the art of bandaging specific body parts on full-sized linen dolls. The text describes several other simulated models such as using vegetables to practice cutting, excision on leather pouches or animal bladders filled with fluid, and cauterization of pieces of meat.⁷

With the development of anesthesia and the aseptic technique leading to a boom in the field of surgery, surgical SBT evolved throughout the 19th and 20th centuries with better models to teach specific procedures such as hernia repair, intubation, and ocular surgery. Some of the simulators were hybrids with both artificial and human parts.⁷ In addition, cadaveric and animate animal models became more commonplace. Living anesthetized pigs were often used throughout the latter half of the 20th century to teach medical students and surgical residents operative skills in a simulated environment. This practice was largely abandoned in the beginning part of the 21st century secondary to the associated regulatory cost and pressure to use inanimate models; recent pressure to return to this model has been noted, however,

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