Chapter 23
Alice in Simulation-Land:
Surgical Simulation in Medical Education

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ABSTRACT

Surgical education has been compressed by integrated residency programs and restrictions on the number of hours surgical residents are allowed to work. Instilling basic technical skills as early as the first year of medical school can help maximize preparedness for surgical rotation and residency. This overview includes a detailed description of low, medium, and high-fidelity simulation-based training techniques and recommends introduction of surgical simulation early in the medical school curriculum. A personal vignette highlights this recommendation.

INTRODUCTION

For decades, surgical education was modeled after Halsted who felt residents should live in the hospital and care for patients in a longitudinal manner to understand the natural history of disease with and without surgery (Polavarapu, Kulaylat, Sun, & Hamed, 2013). Unfortunately, this approach resulted in a workload which usually totaled 100-120 hours per week or more (Hutter, Kellogg, Ferguson, Abbott, & Warshaw, 2006). The Accreditation Council for Graduate Medical Education Residency Review Committee (ACGME RRC) determined that an 80-hour work week is more conducive to learning and a healthy lifestyle (Philibert, Friedmann, Williams, & ACGME Work Group on Resident Duty Hours, 2002). All surgical residents are now restricted to "duty hour" regulation renamed "clinical work hours" in 2017 (Table 1). Despite efforts to achieve improved life balance and patient safety, the 80-hour cap

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on resident work is estimated to decrease caseload by 28% in year one and 36% in year two of residency (Kamine, Gondek, & Kent, 2014). The influential paper "Why Johnny cannot operate" asked 114 residency program directors what operations graduating general surgery residents should be able to competently perform. The 121 procedures deemed essential by residency program directors were ranked by frequency performed and revealed an exponential decrease with nearly one-quarter of procedures never performed by graduating chief residents (Bell, 2009). Likewise, more than 20% of general surgery residents lack confidence in their surgical skills (Coleman, Esposito, Rozycki, & Feliciano, 2013). Trends toward integrated residencies compressing traditional general surgery (5-6 years) plus fellowships (1-3 years) into 6-year comprehensive programs has compounded the problem of potential gaps in resident experience and progression (Grant, Dixon, Glass, & Sakran, 2013). Many have observed that surgeons are less practice-ready and have achieved less graduated responsibility following completion of residency. Widespread concern for preparedness of general surgery residents to enter private practice or fellowship is shared by both fellowship directors and surgery residents (Matter et al., 2013).

Achieving surgical competency in this environment is possible but requires additional focus on the part of educators and participatory learning on the part of students and residents (Bell, 2009). Participatory learning can occur safely in the operating room when trainee autonomy is granted gradually, and competency is documented. The Zwisch scale is a new metric to evaluate the level of autonomy granted in the operating room based on faculty assessment and trust in the learner's ability (least to most trainee autonomy). The graduated scale entitled: Show and Tell, Active Help, Passive Help, or Supervision Only, captures the trainee' s level of independence delegated during the majority of the key portion of a procedure. Each level is defined by specific behaviors, for example, Show and Tell has an attending surgeon perform a procedure that is carefully observed by a trainee. Active help has the attending surgeon lead the case and direct the tasks although the trainee may actually perform the case. Passive help allows the trainee to conduct and perform the procedure while the attending surgeon acts as an occasional advisory assistant. Supervision Only describes a procedure performed by a trainee with minimal unsolicited advice from the attending (George et al., 2014). After a procedure, the educator and trainee are prompted by a smartphone app such as "Zwisch Surgery" to rank operating room autonomy while the procedure is still fresh in their mind. The SIMPL app (System for Improving and Measuring Procedural Learning) tracks resident autonomy and readiness using the Zwisch scale and the validated SIMPL performance scale which labels trainee competency as Unprepared/Critical Deficiency, Unfamiliar with Procedure, Intermediate Performance, Practice Ready, and Exceptional Performance. The largest study of general surgery resident readiness (14 general surgery programs, 444 attendings, 536 residents, and 10,130 procedures), found approximately 80% of general surgery residents reached meaningful autonomy and competency in core procedures in the final 6 months of residency, using the Zwisch and SIMPL scores, respectively (George et al., 2017). The 20% considered deficient confirm concerns regarding surgical resident preparedness.

Increased use of simulation early in a surgeon's career is one possible way to improve surgeon readiness before they begin 3rd year medical school rotations or residency. Simulation training for surgery residents has been driven by the success of aviation and the military where young learners achieve a high level of proficiency and responsibility in a compressed educational process (de Montbrun & Macrae, 2012). Simulation based training helps medical students acquire basic technical skills needed during surgical rotations which function as auditions for highly competitive residency programs. Once a medical student matches to a surgical residency, additional burden to acquire surgical skills is immediate. Some institutions have introduced surgical skill boot camps to help incoming residents achieve a consistent level of