

## EDUCATIONAL SCHOLARSHIP

# Creating a Surgery Clerkship in a Changing Environment: Reality, Simulation, and the Rules of Engagement

Leigh V. Evans, MD<sup>a</sup>, and Richard J. Gusberg, MD<sup>b\*</sup>

<sup>a</sup>*Department of Emergency Medicine and* <sup>b</sup>*Department of Surgery, Yale School of Medicine, New Haven, Connecticut*

This review describes the current challenges associated with creating a successful surgical clerkship and the ways in which teacher-focused and curriculum-focused initiatives can address these challenges. The challenges are both systemic (reflected by changes in our health care system and training programs) and institutional (reflected by factors that affect curriculum design and faculty advancement). Particular attention is paid to residents as teachers, faculty as mentors, the educational impact of the operating room, and the role of simulation. Strategies for engaging students, residents, and faculty are explored. The premise and impact of a comprehensive simulation course on the clinical education of medical students is detailed. Emphasis is placed on the educational validity of accountability and engagement of both the teachers and the learners.

## INTRODUCTION

In 1932, a Commission on Medical Education report to the Association of American Medical Colleges (AAMC†) on the state and goals of medical education emphasized the importance of providing opportunities to expand students' knowledge of basic science and clinical problems, "training in scientific inquiry," and exposing students to the "inspiration and point of

view which come from association with those who are devoting themselves to education, research, and practice" [1]. The report went on to state that the role of the faculty is one of "guidance, inspiration, and leadership in learning. The student and the teacher, not the curriculum, are the crucial elements in the educational program." More than 50 years later, in 1984, the AAMC produced the influential report of the Panel on the General Professional Edu-

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\*To whom all correspondence should be addressed: Richard J. Gusberg, MD, Professor of Surgery and Radiology, Department of Surgery, Yale School of Medicine, 310 Cedar Street, Boardman 2, New Haven, CT 06510; Tel: 203-785-2561; Fax: 203-785-7556; Email: richard.gusberg@yale.edu.

†Abbreviations: AAMC, Association of American Medical Colleges, GPEP, General Professional Education of the Physician; OR, operating room.

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cation of the Physician (GPEP) and College Preparation for Medicine entitled "Physicians for the Twenty-First Century" [2]. While acknowledging the rapid expansion in knowledge, technology, and specialization, the report affirmed that "all physicians, regardless of specialty, require a common foundation of knowledge, skills, values, and attitudes" [2]. Despite the rapidly changing environment in which we currently educate and train the next generation of physicians, the basic educational premise remains the same as that stated in the 1932 report: The success of our educational programs must be judged in the context of the impact of the interaction between student and teacher.

In the several decades since that last 1984 AAMC report, knowledge and technology have continued to advance, our health care system has come under increasing scrutiny and stress, and many traditional premises that have guided medical schools and academic medical centers have been challenged. The environment in which we are expected to educate and train the next generation of physicians has clearly shifted. Patients, health care providers, and students now have broad and ready access to medical information on the Internet. Resident duty hours limit the time residents spend in the hospital. Concerns about efficiency and cost as well as administrative and financial pressures preoccupy health care providers. The education of medical students focuses increasingly on the development of both clinical and communication skills. The emphasis on efficiency and outpatient care limits the exposure of students to clinical problems in the hospital setting. The rapid advance and application of new technology increases the breadth and complexity of treatment options and complicates the decision-making faced by doctors and their patients. The increasing public concern about patient safety has resulted in an increased scrutiny of our educational and clinical practices and use of simulation technology and simulated environments in the education and training of medical students. It is clear, therefore, that the clinical education of our students is now taking place in an environ-

ment in which the challenges faced by the teachers, the students, and the patients may pose significant obstacles to not only patient-centered care but also student-centered learning.

Despite the recognition that there are individual differences in learning styles [3], optimal learning is thought to occur when certain basic conditions are met: clearly defined expectations and learning objectives; problems that seem important and generate on the part of the learner a "need to know;" and a degree of engagement that reflects a personal responsibility for learning [4]. While these educational premises have remained constant, the educational context in which the acquisition of knowledge and skills is expected to take place has changed. For students with the ready availability of information (often carried in their electronic pocket-held devices), knowing the answers can be relatively easy if they know what questions to ask. The qualities that will exemplify clinical excellence in the 21st century will not be based primarily on how much you know, but on the extent to which you are able to assimilate and apply the explosion in knowledge and technology, whether you can assess and solve problems in a priority driven manner, whether you know what questions to ask when confronting a clinical problem or a patient, and whether you can listen and respond to the needs of the patient while communicating with him or her in an empathetic and understandable way. Acknowledging the nature of the context in which we work and teach and recognizing that the majority of students will not be surgeons, a Surgery Clerkship must focus on skill development that is relevant to the general education of medical students while still emphasizing the compelling nature of surgical problems and problem solving. For many students, the clerkship may be their sole, formal exposure to surgical problems and surgeons. Furthermore, recognizing that medical school is a professional school, and not just a graduate school of basic and clinical science, there must be a focus on professional and career development as well as clinical development. The

students must choose a career path, a residency to which to apply, and for most students, these decisions are formulated and finalized during the third-year clerkships.

### **CLERKSHIP IN SURGERY — THE PREMISE AND THE CHALLENGES**

While the role of a Surgery Clerkship in the clinical education and professional development of medical students is substantial, so are the multiple clerkship-specific challenges faced in developing a program with a positive and sustainable impact [5]. Students are more likely than not to enter medical school, and the Surgery Clerkship, with a negative view of surgeons [6]; yet, an optimal learning environment requires a dynamic defined by both engaging teachers and engaged learners. Surgeons' unpredictable clinical schedules, due to many emergencies and being at the mercy of operating room inefficiencies, limit the reliability and availability of faculty and residents for teaching. Clinical responsibilities as well as administrative and academic pressures may leave little time for teaching, and teaching time competes with the non-teaching responsibilities that are more likely sources of remuneration and/or career advancement. Residents, who serve an important teaching role during clerkships, generally receive little if any training as teachers, are not necessarily evaluated and promoted on the basis of their teaching, and have many other clinical and non-clinical responsibilities both in and out of the hospital. Duty hour regulations place time constraints on residents, limiting the time and incentive for teaching. Clerkship learning objectives are unlikely to be matched by exposure to cases that happen to "walk in the door," requiring that a substantial portion of knowledge acquisition and clinical skill development occur in settings away from the bedside and the operating room. Lastly, all clerkships must face the reality of the need for integration across specialties with multiple disciplines competing for student attention and curriculum time.

For a clerkship to successfully meet these challenges, there must be a commit-

ment to teaching despite those challenges by both faculty and residents, a commitment to self-directed learning by the students, innovative approaches to an away-from-the-bedside core curriculum, and a culture that fosters engagement in the educational enterprise. Focusing on the critical elements of the clerkship (the residents, the faculty, the curriculum, and the operating room), the following section will describe the ways in which the Surgery Clerkship at Yale has confronted these challenges.

### **THE SURGERY CLERKSHIP AT YALE**

The Yale Surgery Clerkship, as currently structured, is in its sixth year. Its fundamental premise is to contribute in a meaningful way to the general education and clinical development of third-year students while also engaging students in an experience and dialog that facilitates their career development. This has been the premise from the outset. Feedback from faculty, residents, and students has resulted in annual modifications that have consistently enhanced the program. As it strives to be responsive to both student feedback and health care changes, the clerkship can in many ways be considered a "work in progress."

Clinical management, differential diagnosis, taking histories, and performing physical examinations are skills that are emphasized in many parts of the curriculum throughout the four years. Striving to further these skills, the Surgery Clerkship has placed particular emphasis on the development of decision-making and communication skills. The Surgery Clerkship may be uniquely positioned to address decision-making because surgical problems tend to evolve over a relatively short and definable timeline. Therefore, the decision-making regarding treatment must be precise, specific, and priority-driven (decisions often related to whether or when to operate), and the feedback is tangible (discovered at surgery or detected by a change in the patient's status with or without surgery). Clinical decision-making in this context requires an under-

standing of the natural history of the disease process with and without the intervention. This means being able to weigh the risks and benefits of all relevant operative and non-operative therapies and explaining them in clear and understandable terms to patients. Students are immersed in a context that can provide them with a compelling opportunity to advance their skills in decision-making and communication, skills that are valuable regardless of future specialty choice. As it contributes to their general education and skill development, the Surgery Clerkship strives to ensure that all students are able to recognize and understand the management priorities for common surgical diseases: how to assess outcomes as they weigh the natural history of the disease process with and without various treatment options, when to operate and when not to, what surgery can and can't accomplish, and when to call for a surgery consultation.

The Surgery Clerkship at Yale, in the sixth year of a revised structure, was developed in an effort to expand the time that students spend on Surgery while creating an integrated multi-disciplinary experience. Additional objectives included: 1) invigorating the core curriculum in a way that reflected the changes in the health care system and addressed the challenges in securing faculty availability and 2) broadening the interface between faculty and students. The Clerkship is part of a 12-week block that includes Surgery, Anesthesia, and Emergency Medicine. These three specialties deal with many problems in common and have mutually enhancing learning objectives. The Surgery rotations occupy 8 of the 12 weeks (4 weeks on a General Surgery service, 2 weeks each on one of the Surgical Specialties). The Surgery core curriculum and a Surgery mentoring program run throughout the 12-week block. The 12-week core curriculum, 6 hours each week, consists of case-based discussions (reflecting the clerkship learning objectives and focused on clinical decision-making and communication) and 3 hours each week of a simulation course. The course uses a high-fidelity computerized mannequin (SimMan 3G) and

clinical scenarios to teach leadership skills, team building, communication, and decision-making.

All clinical clerkships face the challenge of meeting their educational responsibilities to students in the face of time-consuming clinical, administrative, and bureaucratic responsibilities of both residents and faculty. This challenge is accentuated by a culture that inconsistently recognizes and rewards teaching effort and excellence and in which these efforts compete against clinical, academic, and administrative responsibilities that are more clearly linked to remuneration and promotion. All Surgery Clerkships in the United States and Canada attempt to integrate students into clinical teams, expect students to spend time in the operating room, have some sort of core curriculum, and emphasize the importance of the role of residents as teachers. In a recent study of Yale medical students during the third year of Surgery Clerkship, the impact of residents as both teachers and role models, mentoring by faculty, the simulation course, and engagement in the operating room were the factors most often identified with a positive educational experience on the clerkship [7]. The following review will focus on the ways in which these aspects of the clerkship define its educational impact.

## **RESIDENTS AS TEACHERS**

In assessing the educational impact of residents and their role in creating a positive Surgery Clerkship experience for students, Thomas C. King, Professor of Surgery at Columbia, once said "if Chief Residents are good, nothing else matters; if they are bad, nothing else helps." Many studies have documented the central role of residents in the clinical education of medical students [8]; in this capacity, they are role models, mentors, evaluators, and teachers [9]. Despite their major teaching role, residents receive little formal instruction as teachers [10] and duty hours regulations may adversely affect the quantity and quality of resident teaching [11]. Furthermore, these implied roles and responsibilities compete for time and atten-

tion with many non-teaching responsibilities both in and out of the hospital. Given this fact, and recognizing that teaching is both a time consuming and time-inefficient undertaking, the degree to which residents are engaged in the education and career development of students is striking. And the Yale Surgery residents have repeatedly demonstrated a strong commitment to the students and their education. The Yale Medical Student Guide to the Surgery Clerkship is one example of this. Initiated by the residents in response to student input, this 50-page manual (with contributions from 13 residents) provides “survival strategies,” guides to note writing, tips on how best to integrate into the clinical teams and the operating room, recommended reading, and descriptions of each of the surgical services (including the educational objectives, common problems, organizational structure, and roles and responsibilities). It is an impressive effort.

The Department of Surgery sends a clear message in its expectation and support of residents as teachers. Multiple interventions serve to recognize, emphasize, and facilitate the role of residents as teachers and educators. During the internship recruitment process, teaching is identified as an important resident responsibility, a skill that requires development and will be longitudinally evaluated. During the orientation week for the incoming interns, an interactive session, led by the Clerkship Director, focuses on teaching tips, providing feedback, setting expectations, and incorporating teaching into daily clinical activities. In the faculty evaluations of residents, teaching commitment and performance are assessed; residents who receive consistently positive evaluations as teachers get written positive feedback from the Clerkship Director with a copy to the Program Director. Those residents whose teaching evaluations are negative receive constructive feedback and, when indicated, remediation. During monthly meetings of the Surgical Education Committee, the resident evaluations are systematically reviewed, and their teaching evaluations are discussed. In an effort to promote teaching as an important and re-

warding academic activity, selected residents with an interest in surgical education have been enrolled in the highly regarded Resident as Educator course organized and sponsored by the American College of Surgeons. To further emphasize educational program development as an important academic enterprise, one resident each year (during his or her research year) is selected as the Resident Teaching Coordinator and Assistant to the Clerkship Director; responsibilities include troubleshooting as educational issues arise, organizing and leading an introductory orientation and skills session at the beginning of each clerkship block, leading two feedback sessions (at 6 and 12 weeks during the clerkship block) focused on the student experience (and submitting a report to the clerkship director), and participating as a member of the Clerkship Working Group. The Clerkship Working Group, composed of faculty, residents, and students, is charged with the responsibility for educational program development. The working premise is a proactive one, and a variety of initiatives are undertaken and data are generated and analyzed to support both program development and educational research. Furthermore, one senior General Surgery resident each year is chosen as the Chief Resident for Education in recognition of the teaching excellence of the resident accompanied by the responsibility of overseeing the teaching programs for the residents. At the end of each academic year, awards chosen both by residents and students are given at the annual graduation dinner to senior residents to recognize their excellence as teachers. In the aggregate, all of these acknowledgments and responsibilities have progressively created a culture in which the residents view teaching as an activity that is important, evaluated, rewarded, and relevant to both their advancement as well as their academic and career development.

## MENTORING

During the last two decades, mentoring has been increasingly cited as being beneficial for the personal and professional growth



of students and trainees, both in and out of medicine. Despite this, there are few reports of successfully instituted programs in medical school [12], little data on the outcomes that can be attributed to such programs, and most of the reported programs focus only on research development or career counseling. Five years ago, a mentoring program was established as an integral part of the Surgery Clerkship at Yale; this was instituted in response to a perceived need to broaden the meaningful interface between faculty and students, hoping to create a relationship that would facilitate both clinical and career development. Each student is assigned to a faculty mentor with the expectation that the two will meet on the average of 1 hour per week throughout the 12-week clerkship block. It was hoped that such a longitudinal experience would provide both stability and continuity during the inevitable disruptions and discontinuities of a long, multi-specialty clerkship block. The successful Department of Surgery recruitment over the last several years of a large number of faculty with a significant interest in student education has created a growing critical mass of potential mentors to a program that requires a significant faculty commitment. To provide a mentor for each student, there is generally a need for at least 25 mentors during each block. The mentors are selected from a pool of 40 faculty who have volunteered to participate. During the 5 years of the program, student feedback has been utilized to add or eliminate mentors, leading to what is currently a largely stable mentor pool. The nature of the weekly meetings, left to the discretion of the mentor and the student, range from discussions of clinical topics to seeing patients together in office or clinic to providing an opportunity for an end-of-the-week debriefing to a focus on clinical skills or career development. Many of the mentor-student relationships persist beyond the clerkship, and a number of the mentors have served as ongoing career advisors, research mentors, and writers of residency recommendation letters. Reviews of the mentoring program by both faculty and students have been consistently highly positive, cited as

one of the parts of the clerkship with the highest positive impact [7].

## **SIMULATION COURSE**

In 2006-07, a mandatory clinical simulation curriculum was instituted during the 12-week Surgery/Emergency Medicine/Anesthesia Clerkship. Its objectives were to broaden the opportunity for skill development in decision making and communication and in approaching common acute clinical problems that students might not otherwise encounter. Now in its sixth year, more than 500 students have participated in the simulation course. During this 12-week course, students participate in 24 acute care scenarios, which is the most ambitious and largest simulation course offered as part of a clinical clerkship in any U.S. medical school.

Several institutions have published descriptions of simulator-based curricula focused on the educational needs of medical students during their clinical years [13,14-17]. Rather than physical exam findings and history taking, the simulation course focuses on communication skills and priority-driven clinical decision making. These skills are irregularly taught and rarely observed in the traditional clinical teaching of medical students. They are skills that are well suited to be taught and observed with the use of simulation. It is the teaching of these skills that makes the simulation course particularly relevant as part of a clinical clerkship; the relevance of the development of these skills is continually reinforced during the students' clinical rotations on Emergency Medicine and Surgery.

During weekly 1-hour sessions (three sessions of eight students), 24 students participate in 24 clinical scenarios in which they manage acute emergency medicine and surgical emergencies. Two teams, each consisting of four students, manage two 10- to 15-minute scenarios as follows: Three participants and an assigned team leader participate in the first simulated scenario, while the remaining four students observe from behind a one-way mirror; the students then switch roles from participant to observer for a second scenario.

Each student functions as team leader three times during which he or she: 1) leads a team of four students in the clinical management of an acute medical or surgical scenario; 2) requests a consultation from a faculty expert; 3) discusses the care plan with the simulated patient and/or family; and 4) participates in an interactive debriefing session with a faculty expert, faculty debriefer, and team member classmates. The faculty expert has clinical expertise in the topics being covered during the session. During each scenario, the assigned team leader requests a consultation from a specialist. The faculty expert receives this consultation and responds as if a resident or fellow were requesting the consult, offering help or asking for additional information where appropriate. The faculty debriefer focuses on observing team leadership and communication with team members, patients, and the patient's family. At the conclusion of each week's session, students participate in a debriefing session. The faculty expert discusses critical actions related to clinical management, and the faculty debriefer discusses team interaction as well as leadership and communication skills. More than 40 faculty members from the Departments of Emergency Medicine and Surgery have participated as faculty experts and debriefers.

The simulation course at Yale offers third-year medical students the opportunity to participate and be observed by faculty in activities that they are often excluded from on the clinical wards: clinical decision-making in critically ill patients, active participation in consultations with specialists, and discussion with patients and family members with regard to care plan, prognosis, and desired level of intervention. The goal of the simulation course is to ease the transition from medical school to internship when a junior physician may need to independently care for a critically ill patient in the middle of the night with little to no supervision and virtually no previous training.

## THE OPERATING ROOM

Despite the presumption that it is or should be a focal point of the surgical education of medical students, there is no aspect

of the clerkship about which there is more discrepancy between the promise and the practice than the operating room. Many studies have both acknowledged this discrepancy and attempted to address it [18]. Ideally, the operating room should provide an optimal context for active learning, a place in which the clinical problems, treatment decisions, accountable care givers, and all relevant anatomy, pathology, and physiology come together with tangible, detectable consequences. The extent to which the students are engaged in this encounter will determine the impact of the operating room as a learning environment. While studies have shown that engagement in the operating room can increase both student learning [19] and student interest in careers in surgery [7], there are a number of factors that can inhibit teaching and learning as it applies to the student in this setting: 1) the stress and concentration of the surgeon in a difficult operation, focusing the attention of the operating team on the completion of the case to the exclusion of the education of the student; 2) the anxiety of the student, uncomfortable with an ill-defined role in unfamiliar and unwelcoming surroundings; 3) teaching directed to the resident in training rather than to the student and focused primarily on technical issues rather than on basic clerkship learning objectives [18]; and 4) the emphasis on time efficiency that demands the most expeditious completion of the operation. Survey-based studies show discrepant operating room expectations of learning needs between faculty and residents [20], teaching of students that does not reflect stated learning objectives [18], and adverse or unwelcoming behavior by operating room staff that interferes with learning [21]. If there are common themes in these studies, they are that clearly stated teaching/learning expectations for both surgeon and student, preparation prior to going to the operating room, positive and inclusive behavior by the surgeon, and engagement during the operation (either in participating in an educational dialog or performing something technical) will enhance the operating room culture and the learning opportunities for the student [21,22]. Despite the real and

potential impediments to learning posed by the operating room, it remains an intriguing context for students to better understand surgical decision making, the benefits and limitations of operations, and the ways in which surgeons function. An effectively conducted operation speaks to issues of communication, leadership, team building, and stress management.

Beginning in 2007-08, clerkship attention was directed specifically at the operating room with the goal of developing a strategy to change the culture and improve the educational experience of students. The Clerkship Working Group, drawing on both feedback from our own students and the reported national experience, undertook several initiatives. An email was sent by the Clerkship Director to all residents and faculty, emphasizing both the importance of the operating room in the education of the medical students and the associated educational responsibilities of both the students and the surgeons. Operating room (OR) assessment cards were distributed to all third-year students in an attempt to document their experience. These cards, specific to the Yale experience and developed by the Clerkship Director in response to student input, represented a checklist approach to assessing and promoting student engagement in the OR. The students are required to submit the cards following their completion and are asked to assess their experience with regard to several specific items: 1) introduction to the OR team; 2) the opportunity to review the pre-operative imaging, indications for surgery, relevant anatomy, and operative findings; and 3) the opportunity to discuss expected outcomes and participate in some technical capacity. The Clerkship Working Group reviews and utilizes the data in providing feedback to Surgery residents and faculty. All students receive an Operating Room Checklist, a list of goals and objectives that reflect and reinforce the expectations outlined in the OR assessment survey.

As a result of these various initiatives, the positive reviews of OR teaching have increased and the number of students citing poor behavior or inadequate education in the

operating room has diminished significantly. More work needs to be done, but working to create an OR educational culture that is defined by clear faculty, resident, and student expectations, accountability, and feedback has resulted in significant progress.

## **MAKING IT WORK — CHANGING THE CULTURE**

The clerkship, as currently constituted, is in its sixth year. Previously, the curricular time assigned to Surgery was shorter. There was no integration with other disciplines, and the core curriculum sessions were limited, poorly linked with the learning objectives, and inconsistently attended by both faculty and students. Several initiatives have resulted in a change in the culture and an improved educational experience for the students:

1. Meaningful integration with two related disciplines (Anesthesia and Emergency Medicine) that has fostered a sharing of ideas among the clerkship directors and co-teaching among the faculty;

2. A comprehensive core curriculum, reflecting the learning objectives and scheduled at predictable times throughout the 12-week block and with faculty schedules set a year in advance;

3. The simulation course, focused in a unique way on skill development in acute clinical decision making, communication, and leadership and generating a robust and regular faculty commitment from both Surgery and Emergency Medicine;

4. A 12-week mentoring program that along with the core curriculum has provided both continuity and longitudinal faculty-student contact;

5. Efforts to create a culture of accountability with regard to the support and teaching of medical students among both residents and faculty;

6. Repeatedly emphasizing to the students their role in the educational process, highlighting the relevance of self-direction, initiative, and engagement;

7. The creation of the Clerkship Working Group, with active student partici-



pation establishing a “work in progress” mentality that encourages student input and involvement in program development with the goal that the students invest in the clerkship and take ownership of it; and

8. An informal dinner at the home of the Clerkship Director one night during each clerkship block to provide a relaxed opportunity for the students to connect with peers and faculty and get a glimpse of life after residency.

## CONCLUSION

A clinical education program will be successful and sustainable only if several criteria are met: the learning objectives are clear, the expectations for both the teachers and the learners are clearly understood, the students and faculty are equivalently engaged, and a culture of accountability exists. The Surgery Clerkship at Yale is significantly more robust and successful than was the case in the past. If this success is to be progressive and sustainable, we must continue to function with a clear vision of our goals and a commitment to continual renewal and improvement. Or, as cautioned in a Sioux proverb: “If you don’t know where you’re going, you’re unlikely to get there.”

## REFERENCES

- Rappleye W. Medical Education: Financial Report of the Commission on Medical Education. New York: Association of American Medical Colleges’ Commission on Medical Education; 1932.
- Physicians for the Twenty-First Century: The GPEP Report. Association of American Medical Colleges; 1984.
- Jack MC, Kenkare SB, Saville BR, Beidler SK, Saba SC, West AN, et al. Improving education under work-hour restrictions: Comparing learning and teaching preferences of faculty, residents and students. *J Surg Educ.* 2010;67(5):290-6.
- King T. Teaching surgeons to teach. *Amer Coll Surgeons Bulletin.* 1987;72:5-9.
- DaRosa D, Skeff K, Friedland JA, Coburn M, Cox S, Pollart S, et al. Barriers to effective teaching. *Acad Med.* 2011;86:453-9.
- Naylor RA, Reisch JS, Valentine R. Do student perceptions of surgeons change during medical school? A longitudinal study during a four year curriculum. *J Am Coll Surg.* 2010;210:527-32.
- Berman L, Rosenthal MS, Curry LA, Evans LV, Gusberg R. Attracting surgical clerks to surgical careers: role models, mentoring, and engagement in the operating room. *J Am Coll Surg.* 2008;207:793-801.
- Langenfeld SJ, Helmer SD, Cusick TE, Smith R. Do strong resident teachers help medical students on objective examination of knowledge? *J Surg Educ.* 2011;68:350-4.
- Whittaker LD, Estes NC, Ash J, Meyer L. The value of resident teaching to improve student perceptions of surgery clerkships and surgical career choices. *Am J Surg.* 2006;191:320-4.
- Minor S, Poenaru D. The in-house education of clinical clerks on surgery and the role of housestaff. *Am J Surg.* 2002;184(5):471-5.
- Brasher AE, Chowdhry MS, Hauge LS, Prinz R. Medical students’ perceptions of resident teaching: have duty hours regulations had an impact? *Ann Surg.* 2005;242(4):548-53.
- Frei E, Stamm M, Buddeberg-Fischer B. Mentoring programs for medical students—a review of the Pub-Med literature 2000-2008. *BMC Med Educ.* 2010;10:32-6.
- Weller J, Robinson B, Larsen P, Caldwell C. Simulation-based training to improve acute care skills in medical undergraduates. *New Zealand Medical Journal.* 2004;117(1204):U1119.
- Gordon JA, Shaffer DW, Raemer DB, Pawlowski J, Hurford WE, Cooper J. A randomized controlled trial of simulation based teaching versus traditional instruction in medicine: a pilot study among clinical medical students. *Adv Health Sci Educ Theory Pract.* 2006;11:33-9.
- McMahon GT, Monaghan C, Falchuk K, Gordon JA, Alexander E. A simulator-based curriculum to promote comparative and reflective analysis in an internal medicine clerkship. *Acad Med.* 2005;80:84-9.
- Brim NM, Venkatan SK, Gordon JA, Alexander E. Long-term educational impact of a simulator curriculum on medical student education in an internal medicine clerkship. *Sim Healthcare.* 2010;5:75-81.
- Weller J. Simulation in undergraduate medical education: bridging the gap between theory and practice. *Med Educ.* 2004;38:32-8.
- Irani JL, Greenberg JA, Blanco MA, Greenberg CC, Ashley S, Lipsitz SR, et al. Educational value of the operating room experience during a core surgical clerkship. *Am J Surg.* 2010;200(1):167-72.
- Schwind CJ, Boehler ML, Rogers DA, Williams RG, Dunnington G, Folse R, et al. Variables influencing medical student learning in the operating room. *Am J Surg.* 2004;187(2):198-200.
- Pugh CM, DaRosa DA, Glenn D, Bell R. A comparison of faculty and resident learning

- needs in the operating room. *J Surg Educ.* 2007;64(5):250-5.
21. Curry SE, Cortland CI, Graham M. Role modeling in the operating room: medical student observations of exemplary behavior. *Med Educ.* 2011;45(9):946-57.
22. Iwaszkiewicz M, DaRosa D, Risucci D. Efforts to enhance operating room teaching. *J Surg Educ.* 2008;65(6):436-40.