New Paradigms in Orthopedic Education

James W. Bogener, MD; Mark Bernhardt, MD; Akin Cil, MD

Since the Institute of Medicine’s release of the report To Err is Human in 1999, which estimated that up to 98,000 individuals die of preventable medical errors per year in the United States,1 it has been clear that medical education must be re-envisioned. In response, the Accreditation Council for Graduate Medical Education (ACGME) introduced 6 domains of clinical competency for all residency programs, worked to limit resident work hours, and has most recently introduced the Next GME Accreditation System.2

THE NEXT GME ACCREDITATION SYSTEM

As part of the Next GME Accreditation System, the ACGME developed educational “sub-competencies” and individual milestones for each specialty, including orthopedics. Individual residency review committees were given significant independence to develop milestones for their specialty. The Orthopaedic Residency Review Committee (RRC), as with many other surgical subspecialties, chose to divide the medical knowledge and patient care competency domain into milestones based on specific, core procedures. Attempting to measure the full breadth of orthopedic knowledge with a limited number of “sub-competencies” would be exceedingly difficult and may result in an overly prescriptive curriculum, so the RRC chose to view the procedures they selected as a “biopsy” of resident medical knowledge and patient care.3 Residency programs were given the program goals and objectives as well as the milestones developed by the RRC and then asked to find innovative ways to measure and assess residents’ progression through their 5-year orthopedic surgery residency. The Orthopaedic Surgery RRC chose 16 sub-competencies in the patient care and medical knowledge domain based on 16 procedures thought to represent a sample of the breadth of procedural knowledge needed for a successful orthopedic career. Systems-based practice was divided into 3 sub-competencies, and the remaining competencies of practice-based learning and improvement, professionalism, and interpersonal and communication skills were divided into 2 sub-competencies. In total, this represents nearly 750 individual milestones used to determine 41 data points reported to the ACGME every 6 months—the most of any specialty.5

GROWING PAINS WITH THE NEXT GME ACCREDITATION SYSTEM

To evaluate resident progress through the ACGME’s milestones, the authors’ institution initially instituted a paper-driven system, which resulted in a significant administrative burden on residents, faculty, and the program coordinator. The printed evaluation tool from the ACGME is 48 pages and needed to be maintained for each resident, resulting in 960 pages of paper for the program every 6 months. To ease the tracking of the paperwork, the authors’ institution then switched to electronic versions of the evaluation sheets provided by the residency management software. Faculty found these forms difficult to access, lengthy, cumbersome, and slow to load, resulting in burdensome evaluation times. As more data were acquired, high variability and little objective data gathering were found. As an example, some post graduate year (PGY) 2 residents received level 4 ratings during their spine rotation in medical knowledge and patient care, indicating they were independently ready to practice spine surgery.
Furthermore, data points gathered in this fashion were sporadic and highly dependent on faculty time and motivation.

**Objective Milestone Data Gathering and Improved Evaluation**

To improve and objectify evaluation of resident progress through the orthopedic milestones, the authors’ institution instituted a novel online evaluation system. Essentially, the system uses multiple-choice questions to evaluate resident medical knowledge, therefore eliminating subjective assessment of medical knowledge by staff. A subjective evaluation of medical knowledge is still obtained at each resident’s end of rotation evaluation and used as part of the final medical knowledge rating created by the Clinical Competency Committee, although previous work has shown that there is poor correlation between the subjective faculty evaluation of medical knowledge and in-training examination scores.6,7 Multiple-choice examinations may not be the perfect instrument to measure medical knowledge, but certification bodies such as the American Board of Orthopaedic Surgery (ABOS) rely heavily on multiple-choice examinations for medical knowledge assessment. Therefore, it is important to understand how residents will perform on such tests.

Patient care, which for orthopedics translates to patient management and surgical skills, is measured by breaking each of the sub-competencies into their individual milestones, and in some cases dividing the individual milestones further into individual procedural steps. These very specific tasks are then sent to the faculty electronically and the faculty provides a “yes/no” answer as to whether the resident is able to perform a specific task. Ideally, this will provide an objective assessment of the resident’s ability to provide quality patient care. During a 5-year residency program, a resident will request approximately 425 of these “yes/no” evaluations, which translates to approximately 10 questions per month. If residents are unable to satisfactorily perform a task, they have the opportunity to try again. The Clinical Competency Committee as well as the individual resident have access to these data to track progress and identify problems in a “real-time” environment.

Systems-based practice, practice-based learning and improvement, professionalism, and interpersonal and communication skills are evaluated on monthly practice examinations that the resident requests from staff and fellow residents. In total, the amount of time needed to complete the paperwork of evaluation is decreased to minutes, thereby allowing faculty to use that time to provide feedback to the resident. The continuous nature of the system also means that a framework for frequent evaluation is established. The overall goal is to decrease administrative burden and increase high-value content such as resident-faculty communication.

**Basic Surgical Skills**

In specialties that require hand-eye coordination and psychomotor skills, efforts are under way to quantify and measure the technical ability needed to safely practice. The American Board of Surgery already requires that applicants show current or past certification in the Fundamentals of Laparoscopic Surgery (FLS), a program designed to be a standardized test of psychomotor skills for laparoscopic surgery. The FLS program has validated metrics that differentiate between novice and proficient learners. Similarly, the ABOS introduced PGY-1 Basic Skills modules in 2013 and made basic skills instruction a required part of the resident experience to take the ABOS Part 1 examination, although the ABOS has not yet required demonstration of proficiency in psychomotor skills. The Orthopaedic RRC has also aligned their core program requirements to include basic surgical skills instruction. Using the ABOS Basic Skills modules themselves is not required by either the ABOS or the ACGME, but basic skills instruction of some form is. Broad latitude is given to programs to develop individual curricula. Furthermore, previous work has documented a steep learning curve in arthroscopic surgery, subjecting patients to risk that may be mitigated by using surgical skills simulation. To this end, the Fundamentals of Arthroscopic Surgery Training program, developed by the ABOS, the Arthroscopy Association of North America, and the American Academy of Orthopaedic Surgeons, is incorporated into the ABOS surgical skills modules.

**Initial Experience at the Authors’ Institution**

The authors’ institution’s program began instituting these changes in 2013 primarily by partnering with industry to do wet labs as well as by partnering with the medical school’s simulation laboratory to provide intermittent instruction and an “Orthopedic Boot Camp,” which has been shown to be effective for teaching some skills to junior orthopedic residents. It quickly became clear that a different model would be needed because industry availability was sporadic at best; there was significant competition for time in the medical school’s simulation laboratory, as it is used by multiple medical disciplines, including emergency medical technician and paramedic students; and residents did not have 24/7 access to any facilities for skill acquisition and maintenance.

**Development of a Comprehensive Basic Skills Curriculum**

In early 2014, the authors’ institution elected to create a department-specific surgical skills simulation center. With a limited budget of less than $40,000, equipment was acquired to complete the ABOS-suggested 17 surgical skills modules as well as the institution’s own wet labs. The institution was well positioned to do this, with space identified for an orthopedic labora-
tory already in place. Residents were granted 24/7 access via key card entry and the laboratory is monitored by security camera, so residents are free to use the laboratory any time to obtain or maintain basic skills. Structured time was introduced in a longitudinal fashion in PGY-1 for skills training.

The initial goal was to provide low-cost, low-fidelity simulation that would improve the learner’s psychomotor skills and eventually allow identification of measurable metrics to show progression. Little evidence exists in the orthopedic literature to differentiate novice and advanced learners in low-fidelity situations and such evidence is nonexistent for the ABOS modules. The literature that does exist addresses high-cost, high-fidelity haptic virtual reality computer-based simulators. Although it is apparent that these simulators do differentiate novice and advanced learners, their cost-benefit ratio remains to be seen.10,11 As such, high-fidelity simulation was considered a long-term goal for the laboratory; however, a grant became available shortly after the laboratory opened that allowed it to acquire a haptic virtual reality computer-based simulator. This simulator will be used not only in resident education, but also to develop appropriate metrics for evaluation and to determine the effectiveness of low-fidelity simulation.

A secondary goal of the laboratory was to support learners throughout their residency. To this end, a comprehensive basic skills curriculum was developed to reinforce skills learned in PGY-1 and to obtain advanced skills in a controlled environment throughout PGY 2-5. Industry remains a valuable partner in this endeavor, allowing the residency access to advanced facilities and implants where residents practice cadaver-based basic and advanced arthroscopic skills as well as trauma and subspecialty-specific skills.

**Future Directions**

In the short-term, significant data will need to be gathered to validate both the ACGME’s milestone project and the ABOS skills module project. Some of this is already under way in rigorous trials, but much remains to be started. In the medium- and long-term, competence and quality will need definitions with defined metrics for assessment. Some data exist to support the translation of surgical skills learned in the laboratory to the operating room, but additional research is needed.

Increasingly, the public and regulators are pressing for quality over quantity, including in the domain of postgraduate medical education. To demonstrate the already high-quality medical education provided to orthopedic residents, metrics must be defined for excellent orthopedic surgeons, outcomes must be objectively measured, and both must be able to be reported when necessary.

**REFERENCES**

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