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AOA Critical Issues

Can We Agree on Expectations and Assessments of Graduating Residents?

2016 AOA Critical Issues Symposium

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Abstract: Orthopaedic educators are responsible for training a prepared and competent workforce that will provide effective care for a growing number of patients with musculoskeletal conditions. Currently, there are both internal and external forces that pose substantial challenges to medical students, residents, program directors, faculty members, and chairs in achieving this goal. One area of particular concern is the education of surgeons, whose knowledge and professional behavior must be matched by their ability to acquire procedural skills. In order to address this issue, many training systems have implemented a competency-based training approach into their curricula. This article discusses the efforts that orthopaedic training bodies in Canada and Australia have taken toward competency-based education and what steps the American Board of Orthopaedic Surgery (ABOS), the Council of Orthopaedic Residency Directors (CORD), the American Orthopaedic Association (AOA), the American Academy of Orthopaedic Surgeons (AAOS), and the Accreditation Council for Graduate Medical Education (ACGME) are considering to improve residency education in the current and future environments.

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Dating back to the time of William S. Halsted in the late 1800s, the surgical education of residents involved graduated responsibility and independence, and residents would take responsibility for their own education. It was assumed that the experiential learning that would occur over long work hours and extensive exposure to patients would result in clinical competence.

This model of training is no longer possible. An emphasis on patient safety, increasing medical liability, the pressure on faculty for clinical productivity, the intensification of hospitals with increasingly complex patients requiring highly specialized care, the importance of private patients and the high-profile nature of academic centers, the involution of indigent-care institutions,

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work-hour restrictions, and generational differences have challenged the ability of residents to acquire the necessary experience and for residency programs to ensure that graduates are competent. The educational environment, including hospital administrators, health-care providers, patients, and even faculty, has become increasingly intolerant to the learner.

Organizations charged with training the next generation of orthopaedic surgeons have organized internationally to consider a new approach to surgical education and training. This symposium focuses on the Toronto experience in competency-based education, the efforts of the Australian Orthopaedic Association (AOA Australia) in redesigning its curriculum for orthopaedic residents, and the efforts of the American Board of Orthopaedic Surgery (ABOS), the Council of Orthopaedic Residency Directors (CORD), the American Orthopaedic Association (AOA), the American Academy of Orthopaedic Surgeons (AAOS), and the Accreditation Council for Graduate Medical Education (ACGME) to improve residency education in the current and future environments. All emphasize the importance of frequent and meaningful assessment and the requirement that residents reclaim ownership of their education.

Canada's Current State of Competency-Based Medical Education in Orthopaedic Surgery

Currently, residency training in orthopaedic surgery in Canada is time-based[1]. All residents must complete 5 years of training, during which a maximum of 8 months of off-service rotations are done in the first 2 years of training. Upon successful completion of the 5 years of training, a resident can challenge the Royal College of Physicians and Surgeons of Canada certification examination in order to be given a license to practice orthopaedic surgery independently.

Time-based training in orthopaedic surgery has been the standard for almost a century in North America. With the current challenges facing surgical training, as mentioned above, alternative methods of training have been suggested. One of these alternatives involves using a competency-based medical education (CBME) approach, which refers to an outcomes-based approach to the design, implementation, assessment, and evaluation of medical education programs, using an organized framework of competencies.

The Division of Orthopaedic Surgery at the University of Toronto began a pilot training program in CBME, known as the Competency-Based Curriculum (CBC), in 2009[2]. The CBC redesigned the training curriculum into 3 phases of training that were composed of 21 different modules (Table I). The first phase of training focuses on modules that teach and assess basic skills and knowledge, the second phase focuses on modules related to more intermediate levels of surgical training, and the third phase focuses on the advanced skills and knowledge relevant to a resident's final year of training.

The CBC pilot training program was not time-based. Trainees would be on a module for as long as it took for them to become competent. This pilot training program ran alongside the regular stream of training in the division, which was time-based (i.e., 5 years).

The curriculum was designed not only to ensure that trainees were competent in the medical expert roles, but also in all of the other CanMEDS (an educational framework that is the basis for the educational and practice standards of the Royal College of Physicians and Surgeons of Canada) roles, such as professional, collaborator, communicator, manager, health advocate, and scholar. The teaching and assessment of the CanMEDS roles are taught with equal frequency throughout each training phase (Table I).

TABLE I Overall Curriculum Map for Competency-Based Curriculum in the Division of Orthopaedic Surgery, University of Toronto*

Phase 1									
Module	1	2	3	4	5	6	7	8	9
Name	Orthopaedic boot camp	Hip and basic fractures	Emergency surgery	Medical comorbidities in the surgical patient	Basic sports	Basic arthroplasty	ICU	Core training in surgery	CanMEDS core competencies
Role	Prof	Sch, C	HA, Com		C, Prof	Com, Man			
Phase 2									
Module	10	11	12	13	14	15			
Name	Pediatric fractures	Spine	Foot and ankle	Basic science	Hand and upper extremity	MSK medicine			
Role	HA, Sch	Com, Prof	C, HA		Man, Com	C, Sch			
Phase 3									
Module	16	17	18	19	20	21			
Name	Oncology	Complex trauma	Complex arthroplasty	Pediatric orthopaedics	Advanced sports	Research			
Role	Prof, Com	Man, Com	Man, HA	Prof, C	Sch, C	Sch			

*This table shows the CanMEDS roles (indicated by abbreviation) that were taught and assessed in each training module. ICU = intensive care unit, Prof = professional, Sch = scholar, C = collaborator, HA = health advocate, Com = communicator, Man = manager, and MSK = musculoskeletal.

Essential to the CBC was the fact that trainees would be formally assessed in their skills and knowledge at 2 time points in each module. The first assessment point would be midway through a module; the second would be at the end of the module. During these assessments, evaluations of performance would occur, including oral and written examinations, the observation of a trainee taking care of a new patient in the clinic, and the ability of a trainee to manage surgical procedures relevant to a particular module. Assessment tools to determine the level of competence in all of the CanMEDS roles were developed. After these evaluations, formal meetings would occur where summative and formative feedback would be given to the trainee. If deemed competent at the end of a module, the trainee would then move on to the next training module. In the University of Toronto's CBC training program, a resident is deemed competent if he or she possesses the required knowledge, skills, values, and attitudes deemed necessary in each training module. The goal of the program is to train a surgeon who is able to manage routine orthopaedic conditions that would be encountered in his or her first year of practice in a community-based setting.

Competence is determined through multiple assessments and faculty opinion. The time required to attain competence is variable, depending on the learning curve of the trainee; however, all residents thus far have completed the program in ≤5 years. It is possible that defining the expected outcomes of training has resulted in a more efficient process. If a resident does not achieve the desired outcome on any measure, a focused remediation program is undertaken. If remediation is not successful, counseling regarding a possible change in career choice may result.

The outcomes of the CBC have been positive for the residents, the faculty, and the training program. The benefit of the CBC for the residents is that each trainee knows exactly where he or she is in the competence curve at any given time. Each CBC resident obtains 3 to 5 times more feedback than residents in the regular stream of training. The training program has been better able to identify residents having difficulty, and also has had some trainees who are able to accelerate through the CBC and graduate in <5 years.

Challenges to Faculty with the CBC

Despite the multiple benefits of the CBC, there have been substantial challenges in its implementation. First, the CBC is resource intensive. The cost of simulation to teach and assess trainees has been found to be 15 times higher in the CBC compared with the cost of using it to teach and assess trainees prior to the initiation of the CBC[3]. With regard to the faculty, the CBC has taken time to be accepted and adapted. The amount of faculty time spent on assessing and teaching trainees has increased threefold[3]. Faculty development needs continuous updating as the program matures.

With regard to scheduling, the pilot CBC model, which was not time-based, was very difficult to organize in a training program with 60 residents. Organizing the call and work schedules for trainees that were on modules until they were competent was difficult to manage. As such, the training program decided to make the CBC a hybrid training program in 2013.

Additionally, considering the immense amount of information that comes from all of the assessments of the trainees, there has been a strong need for an effective information technology support system to house all of the assessment forms and teaching packages on a web-based server, which can be accessed by the trainees, the faculty, and the training program's administration team.

Despite the challenges encountered, the CBC in Toronto continues to flourish and is the model for the current and future training program. In 2011, the Royal College advocated for a nationwide CBME approach to curriculum planning in all specialties. The plan was to initiate a "competence-by-design" approach to curriculum development for all postgraduate medical education programs between 2016 and 2022[4]. This movement should ensure that physicians are competent in all phases of their training, including when they enter residency from medical school, throughout residency, when they transition to independent practice, with independent practice, and when they transition to retirement. The orthopaedic surgery specialty committee will work on the planning and implementation of this initiative in 2018, and will implement it nationwide in 2020 and 2021. With 7 years of experience with the CBC, the University of Toronto looks forward to assisting its colleagues nationally in implementing the competence-by-design plan.

AOA 21—The Australian Experience in Orthopaedic Surgical Education Transformation

In 2012, the AOA Australia undertook a survey of members to establish their views on the most important functions of their association. An overwhelming majority of members considered its main role to be the postgraduate education of orthopaedic trainees (residents). With this mandate, the association undertook a strategic education review, and engaged Drs. Jason Frank and Doug Hedden from the Canadian Royal College for their expertise in contemporary postgraduate medical and surgical education.

This strategic review, completed in 2013, created 4 main deliverables:

1. A review of existing structure and pedagogy across Australia in orthopaedic surgical education and training. The AOA Australia is responsible for orthopaedic training nationally and uses a time-based structure and processes that are very similar to the Canadian model described above. The team created an "as is" overview, using interviews with AOA Australia members and residents, site visits throughout the country, and group discussions and individual interviews in training hospitals.

2. A summary of leading educational practices across postgraduate medical education, with a focus on surgical education, across the globe.

3. A frank account of the strengths and challenges within current orthopaedic surgery education and training in Australia, framed as "opportunities for excellence."

4. An implementation roadmap to guide the journey toward world-recognized best practice in orthopaedic surgical training.

This review demonstrated that surgical and medical expertise competencies were, for the most part, well covered. However, many aspects of training were identified for improvement, including the relevance of the curriculum; the quantity, quality, and facility of current workplace-based assessment; and teaching and assessment in the "nontechnical" competencies.

An 8-year implementation plan was developed from this work, branded "AOA 21" for its twenty-first century goals that will be completed by 2021 (Table II). These included a revised curriculum (completed) based on the key attributes required of an orthopaedic surgeon on his or her first day of independent practice. With this in mind, procedural skills were stratified into 3 levels: level 1 (be able to perform independently), level 2 (have observed, assisted with, or performed under supervision), and level 3 (be able to discuss how the procedure would be performed). A greater focus was placed on the "nontechnical" competencies (e.g., communication, professionalism, and teamwork), which were emphasized as "foundation" competencies (deliberately taught and assessed as the central tenet of quality patient care).

A phased introduction of workplace-based assessments is in progress, both for learning and of learning, based on the principles of programmatic assessment developed by van der Vleuten et al.[5]. A suite of workplace-based assessment tools and an eLogbook have been created, and they are delivered through a readily accessible smartphone application (App). All assessments (patient consultation, management plans, case-based discussion, and surgical skills assessment), the eLogbook, and a trainee-initiated feedback App are captured within a central database (the Trainee Information Management System). This system provides aggregated information for resident review and reflection in an ePortfolio, and supports trainers with real-time access to a dashboard of performance metrics, informing their decisions around areas of targeted instruction or proficiency. The Trainee Feedback App has been created and piloted to encourage deeper learning through contemporary educational concepts of "entrustability" and effective feedback[6,7].

Realignment of the regionally coordinated delivery of teaching ("Bone School"), using an 18-month repeating

TABLE II AOA Australia Training Program*

		Selection	Review of Competence to Progress		Review of Eligibility for Fellowship
Stage	Prerequisites	Introduction to orthopaedics	Core orthopaedics	Transition to consultant practice	Fellowship
Approximate time frame	12 to 36 months	12 to 18 months of quarantined posts	Approximately 36 months	Approximately 12 months	Career
Assessment	GSSE (or equivalent)	Portfolio:	Annual review of portfolio:	Research project	
		Mandatory modules with assessment	Applied knowledge examination (MCQ, SAQ) in early years of this stage	Workplace-based assessment relevant to plan	
		Attendance at bone camp	Online modules for topic areas	Presentation of portfolio	
		Trainee Feedback App: all quick mobile device entries	Trainee Feedback App: all quick mobile device entries		
		Supervisors: evaluation forms Patient assessment Management plans Surgical skills Multisource feedback	Supervisors: evaluation forms Patient assessment Management plans Case-based discussion Surgical skills		
		eLogbook of level-1 and level-2 surgical skills	eLogbook of level-1 and level-2 surgical skills		
		OBS examination	Critical appraisal, presentation skills		
			Clinical examination at end of stage		

*GSSE = Generic Surgical Sciences Examination, MCQ = multiple-choice questions, SAQ = short-answer questions, and OBS = Orthopaedic Basic Science.

TABLE III List of ACGME Procedural Milestones for Assessment

Anterior cruciate ligament reconstruction
Operative treatment of ankle, midfoot, and hindfoot arthritis
Internal fixation of ankle fracture
Carpal tunnel release
Operative treatment for degenerative disease of the spine
Operative treatment of diaphyseal femur and tibia fracture
Operative treatment of distal radius fracture
Operative treatment of adult distal humerus fracture
Total hip arthroplasty
Total knee arthroplasty
Operative treatment of hip fracture
Operative treatment of long-bone metastases
Knee arthroscopy for meniscal derangement
Hip arthrotomy for infection in the pediatric patient
Rotator cuff repair
Operative treatment of the pediatric supracondylar humerus fracture

program of topics directly matched to the curriculum, is also in progress. An increased focus has been placed on the incorporation of teaching and assessment of the foundation competencies within these Bone School sessions, which also incorporate non-orthopaedic expertise in areas such as risk management and communication.

It has been necessary to develop and deliver a comprehensive suite of faculty development workshops, including effective feedback and workplace-based assessments, online seminars, and educational resources to equip our surgeon members with evidence-based teaching methods, fit for purpose. Regional delivery of these workshops throughout our training sites commenced in 2014, with positive uptake and feedback. The program has recently been initiated, and the results are preliminary only. Competency is defined by satisfactory performance on all assessment measures. Failure to achieve competency (e.g., as with the CBME in Canada), would involve a focused review and a remediation program to correct deficiencies. The inability to remediate would result in the recommendation that the trainee not graduate.

Other important new initiatives include a review of the training-site accreditation process and policy, improving our current selection processes to incorporate greater internal analysis and international experience, and the restructuring of residents' participation and education in orthopaedic research to embed literature literacy and foster the surgeon scientist. Finally, to embed most of these developments into ongoing professional education after the completion of training and to continue professional development, it has been necessary to create a learning continuum to be used throughout the lifetime of practice.

The AOA 21 project is incorporating global best practice by modernizing and streamlining the orthopaedic curriculum; introducing more valid and purposeful, programmatic assessment; developing AOA Australia member and resident skills to enhance the teaching experience; and using smarter technology to improve the efficiency, flexibility, and transparency of training.

Efforts of the ABOS, the CORD, and the ACGME in Defining the Essential Knowledge, Skills, and Behaviors of Orthopaedic Residency Graduates

There are substantial outside pressures on Graduate Medical Education (GME) in the U.S. These include financial pressures since GME is substantially supported by the Centers for Medicare & Medicaid Services (CMS) and there is a need to decrease the cost of health care. There are also groups outside of GME that have produced reports calling for substantial changes to GME in the U.S. These include the 2014 Institute of Medicine report that encouraged major changes to the structure, function, and finances of our GME system[8].

GME for surgical training arguably presents more difficult issues than for nonsurgical training. One study showed an alarming lack of exposure to core surgical procedures during residency training in general surgery[9]. A survey of general surgery fellowship program directors indicated that many general surgery trainees are ill-prepared for independent practice[10].

Orthopaedic surgical skills are currently acquired through a poorly focused surgical redundancy, which often requires an inordinate amount of resident time spent on taking part in high-level subspecialty procedures, including spine deformity, complex hip revision, and pelvic and acetabular surgery. These types

TABLE IV Procedural Minimums for Case Log Data Submitted to the ACGME for Orthopaedic Surgery*

Procedure	Minimum
Knee arthroscopy	30
Shoulder arthroscopy	20
Anterior cruciate ligament reconstruction	10
Total hip arthroplasty	30
Total knee arthroplasty	30
Hip fracture fixation	30
Carpal tunnel release	10
Spine decompression/posterior spine fusion	15
Ankle fracture fixation	15
Closed reduction forearm/wrist	20
Ankle, hindfoot, and midfoot fusion	5
Supracondylar humeral fixation	5
Operative treatment of the femur/tibia	25
All pediatric procedures	200
All oncology procedures	10

*Total of all cases: at least 1,000, but no more than 3,000, procedures.

of cases currently remain embedded in residency training because of a lack of clear definitions of which procedural skills orthopaedic residents should acquire.

In the U.S., orthopaedic training is time-based, with 5 years of residency; most residents continue with at least 1 year of fellowship. The vast majority of residents who enter training programs successfully complete them in 60 months. Very few leave the training program earlier, and even fewer train for longer, regardless of the amount of competence acquired at the end of that time.

Our current educational system has some important educational positives, and there are things that we do well. There are ACGME-mandated national milestone assessments of resident progress that occur during the 5 years of training, which were developed by the ACGME and the ABOS (Table III). There are also procedural minimums that are recorded by residents nationwide in 15 basic procedures (Table IV). Additionally, we have excellent summative medical knowledge assessments. These include the Orthopaedic In-Training Examination (OITE) during training, the ABOS Part I certifying examination at the end of training, and the practice-based ABOS Part II oral examination after 2 years in practice.

These positives are offset by deficiencies in our current training system. The only attestation of competence that is required is a summative evaluation by the program director at the end of training. Objective metrics are not a part of this assessment of competence. In addition, the required course of training is poorly defined. For instance, the ABOS requires 6 months of pediatric orthopaedics, but the necessary skills, knowledge, and experiences within this subspecialty are not specified. To move toward a competency-based training program, we need to have a curriculum with the essential knowledge, skills, and behaviors that are required at the end of training. We need to identify robust assessments, both formative and summative, to measure resident progress during training and to determine when final competence is achieved.

The ABOS, in cooperation with the ACGME, the CORD, the AOA, and the AAOS, has initiated such a project to define and assess the essential knowledge, skills, and behaviors that need to be acquired by orthopaedic residents during training in order for them to be competent for independent practice. The medical knowledge portion is potentially the easiest to evaluate because we have assessments of knowledge in our examination programs. Defining the core procedural skills necessary to be competent at the end of training and improving the assessment of those skills is more challenging, but achievable. For many years, the United Kingdom has had a competency-based education model that emphasizes frequent assessments of trainee and trainer. In other fields in the U.S., there are many efforts to improve resident assessment and develop curricula. For example, the field of general surgery has piloted the use of electronic procedural assessment tools[11,12]. It is important for orthopaedic surgery leaders to design and implement formative and summative assessments, not only for knowledge and procedural skills, but more importantly, to measure a resident's ability to perform a clinical evaluation and formulate a treatment plan that, if properly implemented, will improve the health and well-being of patients and the health-care system.

Summary

Pressures on surgical education include work-hour restrictions, proliferation of technical advances, privatization of academic medical centers, financial pressure to bill for surgical services, and the patient-safety movement. In order to ensure that graduates are competent to provide care, many countries, including Canada, Australia, and the U.S., are in various stages of adapting and modernizing their orthopaedic GME toward training that is built on competency-based education. Initiatives involve developing a curriculum and a more robust set of resident assessments, utilizing electronic data systems, and engaging residents to be responsible for their educational program. ■

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