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American College of surgeons /Association for Surgical Education Medical Student Simulation-based Surgical Skills Curriculum: Alignment with Entrustable Professional Activities



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ABSTRACT

Background: We hypothesized that medical experts would concur the American College of Surgeons/ Association for Surgical Education Medical Student Simulation-based Surgical Skills Curriculum (“ACS/ ASE Curriculum”) could be used to teach and assess Entrustable Professional Activities (EPAs).
Methods: A “crosswalk” was created between ACS/ASE Curriculum modules and eight EPAs. Medical education experts participated in a Delphi process regarding feasibility of using the modules for teaching and assessing EPAs.
Results: Twenty-eight educators from six clinical fields participated. There was consensus that five of the EPAs could be taught and assessed by the ACS/ASE Curriculum. A median of nine hours per month outside the surgical clerkship was recommended for skills training.
Conclusions: The ACS/ASE Curriculum lays the framework for implementing select EPAs into medical student education. Experts recommended increased time for skills training with incorporation of the modules into the first three years of medical education, with assessments planned in the third to fourth years.

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Introduction

Medical education has been transformed by the patient safety movement and the adoption of residency work-hour restrictions, with increasing emphasis on both safety and efficiency in residency training. This has fostered increased attention on the training expectations of students entering residency, with many program directors expressing concern that student preparation is suboptimal.^{1,2} To address this, the American Association of Medical Colleges (AAMC) convened an expert panel to develop a list of Entrustable Professional Activities (EPAs), describing tasks and responsibilities that should be competently and independently

performed by graduating medical students.³ Although the AAMC EPA panel did not develop a curriculum for teaching and assessing the EPAs, they noted: “The *ideal* implementation and assessment system will give students many opportunities to practice with repeated, low-stakes formative assessments, culminating in entrustment decisions for each of the 13 EPAs by the time they graduate.” This statement suggests that simulation may be an ideal modality to achieve these aims, but individual institutions have been given the flexibility to determine how and when each EPA will be taught, what the content will be, and how the EPA will be assessed.

Institutions searching for methods to implement EPA curricula and assessment might consider the domain of surgery. Surgical educators have a long history of developing curricula, with an overarching goal to develop and disseminate a national curriculum which optimally prepares students for residency. In addition

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to the more cognitive American College of Surgeons (ACS)/Association for Surgical Education (ASE) Core Curriculum,⁴ there are numerous curricula aimed at focused skills training in the senior year.^{5–7} The ACS/ASE Medical Student Simulation Based Surgical Skills Curriculum (hereafter referred to as “ACS/ASE Curriculum”) may be most applicable to EPA training and assessment.⁸ Although created prior to EPA development and publication, its 25 simulation-based modules cover skills identified as essential for all physicians.⁹ The modules are self-contained, 1–2½ hours in length, and can be used either as freestanding learning activities or as part of the entire curriculum. The ACS/ASE Curriculum includes descriptions of the simulation models, a step-by-step discussion of the involved techniques, expert performance videos, and relevant assessment tools for scoring student performance and providing feedback. Pilot studies of the modules at national meetings and schools across the country have demonstrated their feasibility and effectiveness in training students to proficiency.^{10,11} More broadly, the modules have been adopted for simulation-based team training and resident selection.^{12,13} The ACS/ASE Curriculum likely has the potential to meet EPA teaching and assessment needs, but has yet to be thoughtfully examined for this purpose.

The goal of this study is to gain expert consensus on the applicability of the ACS/ASE Curriculum for teaching and assessing EPAs. We hypothesized that medical education experts from a diverse array of specialties would agree that a number of EPAs could be effectively taught and assessed using modules from the ACS/ASE Curriculum. In addition, we sought to explore barriers to adoption and dissemination of national curricula, and ideas for incorporating skills training across the medical student years to ensure trustworthy graduates.

Methods

We first reviewed the ACS/ASE Curriculum to determine which modules could conceivably be used to teach or assess the EPAs. The ACS/ASE Curriculum modules are categorized “based on the year [of medical school] during which they are most commonly taught:” Year 1 contains eight modules, Year 2 contains seven modules, Year 3 contains ten modules. Each module was evaluated for potential alignment with specific EPAs. By consensus, we created a “crosswalk” between the ACS/ASE Curriculum modules and relevant EPAs (Table 1). Not all of EPAs were illustrated in the ACS/ASE Curriculum modules, similarly not all of the modules, particularly technical skills, were described by the EPAs.

Participants

Members of the ASE Simulation Committee solicited experts from diverse specialties and geographic areas, known to them through professional networks, to participate in the Delphi process. Demonstration of expertise was determined by the following criteria: Current role as Dean or Associate Dean of Medical Education, Department Chair or Associate Chair of Education, Clerkship Director, Program Director, or PhD educator published in the field of medical education. Prospective expert participants were then contacted by the research team and asked to commit to the entirety (up to three rounds) of the Delphi process. They were provided the crosswalk as well as full access to the ACS/ASE Curriculum and a summary of each module. This study was approved as exempt by the University of Hawaii investigational review board.

Delphi process

We employed a Delphi process to survey and obtain consensus among medical educators.¹⁴ Responses were collected anonymously to facilitate open discourse.^{15,16} Delphi rounds were planned until agreement of $\geq 75\%$ was obtained on alignment of modules with specific EPAs, per established methodologic criteria for reporting of Delphi studies.¹⁷

Round One consisted of an open-ended questionnaire (SurveyMonkey) with both quantitative (Likert-type scale) and qualitative (open response) items. We solicited specific information regarding the conceptual alignment and feasibility of using individual ACS/ASE Curriculum modules for teaching and assessing specific EPAs (Appendix A). Participants were encouraged to complete the first round within two weeks of administration.

Participant responses to the first round of the survey were collected and converted into a structured questionnaire, which served as the survey instrument for the second round of data collection (Appendix B). In Round Two, each participant reviewed and responded to the structured questionnaire that represented a distillation and summary of participant responses to the prior round's questionnaire. This round required participants to submit a more substantive explanation in support of their responses, giving them an opportunity to make further clarifications of both the information and their judgments of the appropriateness of the module for EPA teaching and assessment. We tabulated areas of agreement and disagreement again using the 75% threshold.

Table 1
Crosswalk for EPAs with modules in ACS/ASE Curriculum.

EPA	EPA DESCRIPTION	YEAR	MODULE#	MODULE DESCRIPTION
1	Gather a history and perform a physical exam	1	1–6	Abdominal, Basic vascular, Breast, Digital rectal, Female pelvic, Male groin and genital examinations
6	Provide an oral presentation of a clinical encounter	2	2	Communication-history and physical, and case presentation
8	Give or receive a patient handover to transition care responsibility	3	5	Communication – Safe and effective handoffs
9	Collaborate as a member of an interprofessional team	3	5	Communication – During codes
10	Recognize a patient requiring urgent or emergency care and initiate evaluation and management	3	5	Communication – During codes
11	Obtain informed consent for tests or procedures	3	4 OR 9 OR 10	Central venous line insertion OR Paracentesis OR Thoracentesis
12	Perform procedures: Cardiopulmonary resuscitation (CPR)	3	5	Communication – During codes
12	Perform procedures: Bag mask ventilation	2	1	Basic airway management
12	Perform procedures: venipuncture, inserting intravenous (IV) line	1	8	Venipuncture & peripheral IV
13	Identify system failures and contribute to a culture of safety and improvement	3	5	Communication – During codes and safe and effective handoffs

Results

Thirty expert medical educators were initially contacted, and 28 agreed to participate in the Delphi. They had the following clinical backgrounds: Internal Medicine (2), Surgery (8), Pediatrics (6), Obstetrics/Gynecology (3), Family Medicine (1), and Social Sciences (8). Academic roles were as Dean/Associate Dean (10), Chair/Associate Chair of Education (4), Clerkship Director (9), Program Director/Assistant Program Director (2), and Simulation Director (2). All major geographic areas of the United States from Hawaii to New England were represented, and 61% were American College of Surgeons Accredited Education Institutes. Twenty-six percent of respondents had used the ACS/ASE Curriculum. The

most commonly used modules were suturing and knot tying (83%), followed by venipuncture/peripheral venous access, basic airway, nasogastric tubes, and sterile technique (50%). Half of those who used the modules had made institution-specific adaptations. Only one respondent was tracking EPAs at their institution.

After the first round of the survey, we achieved consensus regarding the alignment of five of the EPAs with ten of the modules (Table 2). There were numerous formative comments regarding the potential for modifying the modules to better align with the EPAs. Notable was complete agreement that Year 1 Module 8, and Year 2 Module 1 could be used to teach and assess elements of EPA 12: Perform General Procedures of a Physician

Table 2

Alignment of EPAs with modules in ACS/ASE Curriculum. Modules with perceived alignment ($\geq 75\%$ concordance) are highlighted. ACS/ASE Curriculum Year is indicated for those EPAs deemed to be aligned with the modules. Highlighting defines the majority response(s).
BMV = bag valve mask ventilation.
CPR = cardiopulmonary resuscitation.
IV = placement of intravenous catheter.

EPA	YEAR	MOD	TEACH	ASSESS	SAMPLE FORMATIVE COMMENTS
1	1	1-6	88%	95%	Confirm expectations/objectives for history-taking to ensure it encompasses all EPA expectations Most of these modules focus on clinical examination skills but not on obtaining a history
6	2	2	91%	96%	The current rating tool is very basic and focuses only on generic communication skills, which is appropriate for an early medical student. For use with more senior students, I'd want to see a rating tool that rates content - inclusion of pertinent positives/negatives, organization, thoughtful assessment and initial management plan
8	3	5	86%	95%	Module did not seem complete enough for me to use "off the shelf." For instance, there was no script or patient descriptions of the patients to be handed-off. While the rating tool does assess the different components of a safe handoff, I personally prefer the lpass method
9	3	5	83%	91%	It would be better to place the collaboration behaviors within a realistic everyday work context for a medical student. Students are less likely to be involved in codes and they are unlikely to lead code teams. Focus too narrow, communication needed during code is only part of communication skills needed to succeed Doesn't seem to focus or mention much about the "other IP team members". The example is with the learner as the "leader", when this isn't always the case and seems to detract from the goal of IPE which is truly teamwork and everyone has their role
10	3	5	30%	30%	
11	3	4 / 9 / 10	25%	21%	
12	3	5	20%	16%	
12	2	1	100%	100%	I might want a more detailed rating form related to the specific procedure
12	1	8	100%	100%	Excellent checklist, great comprehensive rating tool
13	3	5	35%	21%	

Table 3

Responses to questions regarding the best year of medical school for teaching and assessing EPAs (n = 28).

EPA	ACS/ASE CURRICULUM		WHICH YEAR SHOULD THIS EPA BE							
			TAUGHT				ASSESSED			
	YEAR	MOD #	1	2	3	4	1	2	3	4
1	1	1-6	58%	33%	8%	0	13%	38%	42%	8%
12 – IV	1	8	9%	61%	22%	9%	5%	45%	36%	14%
12 -BMV	2	1	10%	33%	38%	19%	0	23%	59%	18%
6	2	2	22%	65%	13%	0	13%	13%	65%	9%
8	3	5	0	17%	70%	13%	0	5%	50%	45%
9	3	5	5%	27%	55%	14%	4%	9%	43%	43%
10			0	14%	67%	19%	0	5%	32%	64%
12 -CPR			14%	29%	38%	19%	10%	14%	43%	33%
11			5%	9%	68%	18%	5%	0	38%	57%
13			0	20%	50%	30%	0	10%	24%	67%

including bag valve mask ventilation and venipuncture. We conducted a second round of Delphi to attain concordance on the remaining four EPA-module pairings. Twenty-three experts (82%) completed the second round. Conclusions following Round Two were that the remainder of the modules were not sufficient to both teach and assess EPAs 10, 11 and 13, and the Communication during Codes portion of EPA 12.

With the exception of EPA 1 (history and physical), respondents believed that the EPAs listed should generally be taught in the second or third year of medical school, with assessment performed in the third to fourth year (Table 3). However, one provided the clarification: "It would have been nice to be able to select more than one year for the teaching and/or assessment of the EPAs as some may be best done in a tiered, stepwise fashion rather than contained just in one academic year of training."

Narrative responses provided insight regarding barriers to implementing national skills curricula and the EPA paradigm. A quarter of respondents identified lack of curricular time as a barrier to using the ACS/ASE Curriculum, an equal percentage identified faculty buy-in ("my colleagues are stick-in-the-muds"). There was a range of responses to the question: "How much time should be protected/devoted to medical student skills training outside of the third year clerkship?" Responses ranged from approximately 80 minutes to 32 hours per month (median = 9 hours per month). The open-ended question regarding how to assure "trustable" residents elicited a variety of responses with some common themes. (Table 4).

Discussion

The Core EPAs for Entering Residency have been applauded as a framework aligned with competency-based education, designed to improve the transition from undergraduate to graduate medical education. However, educators have struggled with the practical aspects of implementation, particularly in the aspects of formal entrustment, assessment, curriculum and faculty development.¹⁸ The AAMC has provided the EPA toolkit to assist incorporation,¹⁹ but institutions are still tasked to develop or choose their curriculum and assessment tools, determine sequencing, and perform faculty development. This is overlaid on an infrastructure of clinical faculty who may have little time to teach and scant formal educational training.²⁰

The ACS/ASE Curriculum and EPAs share common themes. Both focus on activities that represent the day-to-day work of the physician, are observable, and measurable in their process and outcome. The ACS/ASE Curriculum can provide an implementation framework to build on the theory of the EPAs by defining the content and describing in detail how skills will be taught and assessed. However, since the ACS/ASE Curriculum was developed independently and concurrently with the EPAs, there is a need to demonstrate alignment prior to relying on this, or any, curriculum designed to implement the EPA paradigm.

This Delphi survey suggests that the ACS/ASE Curriculum is a viable model for implementing EPAs. There was agreement that the modules could be used to teach and assess five of the EPAs. Respondents had greater agreement regarding use of the modules for assessment, versus feedback. Although respondents generally agreed that the modules achieved the stated objectives, many of the formative comments regarding use of the ACS/ASE Curriculum suggested adaption of the modules to enhance teaching specific to the EPAs (Table 2). This is corroborated by the practical experience of the 13% who reported the modules were modified for use at their own institution. This feedback will be used to inform revision of future iterations of the modules.

There is a lack of experience and confidence in performing bedside procedures among graduating medical students.²¹ To remedy this lack of preparedness to enter procedural specialties, many institutions have adopted residency preparation courses, aka "boot camps," to ensure resident attainment of Level 1 milestones.^{5,22} Although this just-in-time learning has proven advantageous, a distributive process for simulation-based learning would be expected to improve skill retention.²³ The ACS/ASE Curriculum differs from other skills curricula and "boot camps" in that the teaching and assessment are spaced over years of medical school. The distributive learning concept was endorsed by our respondents who recommended a median of nine hours per month be devoted to skills training outside of the surgical clerkship. The student curricular time for all of the EPA-aligned modules listed in Table 2 totals approximately fifteen hours. Allowing for support time needed to create the simulated environment, as well as repetition of the modules, it would be very feasible to deliver these in the construct of a nine hour per month curriculum.

Table 4
Responses to question: “How do we ensure ‘trustable’ residents?”.

Theme	N = 28	Sample narrative
Repeated low-stakes assessment	11	Repeated, daily, observed performance of professional activities by experienced observers and transparent, daily, repeated feedback about performance and progression toward a mutually understood level of performance.
Standardized assessment tools	5	Combination of rigorous simulation and in situ observation driven by combination of check lists and global scores
Faculty training/development	3	Agreed-upon assessment scheme for a) what entrustable performance is and b) assessors who apply this scheme to simulated and actual EPAs
System for tracking EPAs	3	A system that keeps track of EPA-specific performance assessments, including the number of directly assessed at a defined level of entrustability that feed forward during a resident's training (so residents don't have to re-demonstrate lower level EPAs to faculty just because that particular attending did not personally witness multiple trials of acceptable performance)
Trustworthiness	2	I think a trustable resident is one who will tell me what they know and don't know, and only practice within their knowledge base. That seems somewhat intrinsic/personality based– I'm not sure how promote/develop that.
Other		Students need to be given more graded responsibility with supervision. It seems that we have taken away much student responsibility and have relegated them to observers in many instances. By educating, implementing, monitoring, and evaluating them. How to do all that is a difficult question to answer I think EPAs are pie in the sky, and like all of us, we are not always “entrustable” in that we don't always know what to do in all situation we may face. Separate assessment of truthfulness, insight into assessment of sick or not sick Create multiple methods to assess competency. Make it high stakes, none of this sissy “keep moving up the training hierarchy and we'll just assume you're fine.” Starts with resident selection–self regulated learners and self-reflection skills

Thirty-nine percent of respondents cited “repeated, low stakes assessment” as a critical component to ensuring trustworthy residents. However, respondents generally endorsed a later time frame for teaching and assessing the EPAs than the

initial year-based categorization of the corresponding ACS/ASE Curriculum modules. Specifically, most EPAs were deemed to be best taught in the second to third year, with assessment following in the third to fourth year. One weakness identified for the modules in the context of EPAs was the lack of specific entrustment terminology in the assessment tools. The findings of our Delphi suggest incorporating entrustment terminology, and perhaps recategorizing the modules by anticipated level of entrustment per year. For example, Year 2 Module 2: “Communication-history and physical, and case presentation” might be introduced in the second year with an expected entrustment level of 2 (allowed to practice under full supervision). In the third year, the module may be repeated with an expectation for an entrustment level of 3a (with supervisor immediately available, all findings double checked).²⁴ Due to the simulated environment for the modules, determination of higher entrustment levels may not be possible.

Limitations of this study included the selective nature of the Delphi process, with a relatively high proportion of experts (29%) being surgeons. Also, the respondents had variable prior familiarity with the ACS/ASE Curriculum, which was likely higher than the national average. Another limitation is the lack of entrustment terminology in the modules and inherent ambiguity in the term “assessment.” We assumed assessment to indicate summative assessment, i.e. the highest level of entrustment attainable in the simulated setting for that particular EPA. Further research is warranted to ensure that competence recognized in the simulated setting assures competence in the actual clinical realm.

Conclusions

In summary, the ACS/ASE Curriculum lays the framework for implementing select EPAs into medical student education. The ACS/ASE Curriculum is free, portable, and pilot-tested. Experts recommended increased time for skills training with incorporation of the modules into the first three years of medical education, with assessments planned in the third to fourth years. Alignment with EPAs may be facilitated by adaptation of the modules for individual institutions, as well as national curricular modification, incorporating experts' feedback and EPA entrustment terminology.

Acknowledgements

This work was the product of the Simulation Committee of the Association for Surgical Education.

Appendix A

Survey questions

- What is your background/specialty?
- What is your role?
- Is your institution an American College of Surgeons Accredited Education Institute (AEI)?
- Prior to this survey, were you aware of the ACS/ASE Medical Student Simulation-based Surgical Skills Curriculum?
- Does your institution use any modules in the ACS/ASE Curriculum?
- If so, which module(s)?
- Have you substantially modified the module(s) for your institution?
- What are the barriers to implementing the ACS/ASE Curriculum at your institution?

- In your opinion, how much time should be “protected”/devoted to medical students' skills training outside the third-year surgery clerkship?
- Do you have a platform for tracking graduating students' EPA progress? If so, please explain what type.
- For each of the following EPAs, please respond whether or not you believe that the modules listed could be used to teach and assess them:
 - o Could the following module (*description of and link to module*) be used to TEACH EPA X: (*description of EPA*)? Why or why not?
 - o During which year of medical school should this EPA be taught?
 - o Could the following module (*description of and link to module*) be used to ASSESS EPA X: (*description of EPA*)? Why or why not?
 - o During which year of medical school should this EPA be assessed?
- In your opinion, how can we ensure that we have "trustable" residents?

Appendix B

Example of structured survey question.

The following module from the ACS/ASE Simulation-based Skills Curriculum was proposed as a potential teaching tool for the following EPA. Below is a description of both, followed by participant responses as to why and why not the simulation-based module is appropriate.

Do you think the above module could be used to teach EPA 11? Yes/No.

Why or why not?

The following module from the ACS/ASE Simulation-based Skills Curriculum was proposed as a potential assessment tool for the following EPA. Below is a description of both, followed by participant responses as to why and why not the simulation-based module is appropriate.

Do you think the above module could be used to assess EPA 11? Yes/No.

Why or why not?

EPA	EPA DESCRIPTION	YEAR	MOD	MODULE DESCRIPTION
11	Obtain informed consent for tests or procedures	3	4 OR 9 OR 10	Central venous line insertion OR Paracentesis OR Thoracentesis

Arguments FOR using these modules to teach EPA 11

- Key content covered.
- Appropriate for a simulation-based venue.

Arguments AGAINST using these modules to teach EPA 11

- The focus of this module is on the technical aspects of doing these procedures. It doesn't focus on aspects of how to do informed consent (i.e. Eye contact, allowing patient to ask questions, separating out rating tool for explaining indications, alternatives, risks)
- Informed consent is a broader discussion

EPA	EPA DESCRIPTION	YEAR	MOD	MODULE DESCRIPTION
11	Obtain informed consent for tests or procedures	3	4 OR 9 OR 10	Central venous line insertion OR Paracentesis OR Thoracentesis

Arguments FOR using these modules to assess EPA 11

- With enough interactive capacity, this would be possible.
- Module is appropriate to assess within simulation.

Arguments AGAINST using these modules to assess EPA 11

- The rating tools are not fleshed out enough to truly assess whether a student is ready to be entrusted to obtain consent.
- The focus of this module is on the technical aspects of doing these procedures. It doesn't focus on aspects of how to do informed consent (i.e. Eye contact, allowing patient to ask questions, separating out rating tool for explaining indications, alternatives, risks)
- Central line simply assesses "obtained consent," paracentesis has consent lumped in with time out but is not a separate part of the checklist, and thoracentesis checklist doesn't address consent at all

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