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Evaluation of an instrument to assess resident surgical entrustable professional activities (SEPAs)☆

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ABSTRACT

Background: The purpose of this study was to examine the reliability and the validity of the new surgical entrustable professional activities (SEPAs) instruments.
Methods: A prospective evaluation of six procedure-specific SEPAs instruments derived from the validated OPRS evaluation tools was conducted in 2018. Each instrument includes an open-ended feedback item and a series of Likert-Scale rating items. Attending, resident and a constant 3rd surgeon-observer completed the same evaluation for the observed case within 3 days of each evaluated operation.
Results: 40 cases performed by 10 residents and 11 attending surgeons were observed and evaluated. The SEPAs instruments were supported by strong validity evidence. Factor analysis revealed three latent variables are consistent with the core construct of SEPAs instrument. Internal reliability was high with Cronbach's α ranging from 0.84 to 0.94 across the six procedures. Test-retest reliability varied from 0.74 to 0.93 in the study sample.
Conclusions: The SEPAs instruments are reliable and valid tools for assessment of crucial aspects of resident learning and surgical entrustable professional activities that lead to entrustment and eventually surgical autonomy.

Introduction

Entrustable Professional Activities (EPAs), which were initiated by the Association of American Medical Colleges (AAMC), are gaining popularity in the field of medical education given they provide a practical approach to assessing resident competence in real-world settings.[1] The original AAMC EPAs for entering residency offer 13 generalizable tasks for trainee entrustment measurement. However, these tasks are not designed to address the mounting needs of assessing resident procedure-specific surgical competencies and entrustability in the operating room (OR). As such, there is a need to develop a new surgical EPAs (SEPAs) construct as a complement to the classic EPAs.

Though the American Board of Surgery (ABS) is piloting use of EPAs as a framework in residency evaluation, it still encourages residency programs to use Operative Performance Assessment (OPRS) for evaluating individual resident procedure-specific operative performance.[2–4] OPRS requires an attending surgeon to assess procedure-specific skills and general skill of a resident who scrubs in the attending surgeon's surgical case. In the past, our program used OPRS for six evaluations of each chief resident to meet the ABS requirement. We found, as have others, that the single-rater approach might limit the meaningfulness of the OPRS evaluation. In addition, attending surgeons tend to use observable evidence from four domains (resident characteristics, medical knowledge, technical performance, and evidence beyond the current surgical case) to determine when to entrust a resident with autonomy in the OR.[5,6] To enhance the potential of surgery residency programs to prospectively assess, review and develop surgical resident competencies and entrustability, we developed an expanded version of the OPRS instrument based upon SEPAs. The goal was to design a new tool that could provide multi-faceted feedback on operative performance as well as assessment of future entrustment and autonomy to the resident. The purpose of this study was to evaluate the validity and reliability of this new SEPAs instrument.

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Material and methods

Setting and participants

The Ohio State University College of Medicine General Surgery residency is a university-based, Accreditation Council for Graduate Medical Education (ACGME) accredited training program with six categorical residents in each postgraduate year (PGY). The residency program has 56 teaching faculty practicing in four teaching hospitals. The Ohio State University Institutional Review Board (IRB) approved this study.

SEPAs evaluation instruments

We designed and developed six initial procedure-specific SEPAs instruments by augmenting the validated OPRS[2–4] construct with core entrustment evidence identified from interviews with 43 expert surgeons[5–7] and 39 surgical trainees. The six SEPAs instruments assess laparoscopic cholecystectomy, laparoscopic inguinal hernia, open inguinal hernia, laparoscopic ventral hernia, open ventral hernia, and laparoscopic colectomy.

Prior to this study, we only used OPRS to fulfill the American Board of Surgery's six operative performance assessments requirement for residents applying for the qualifying exam. The research team reviewed the new instruments and discussed discrepancies to reach consensus. Each SEPAs instrument (see example in Appendix) includes an open-ended feedback item and a series of Likert-Scale rating items from three core entrustment components: 1) learning attributes (e.g. learning goal, achieved learning goal), 2) procedure-specific attributes (e.g. procedure-specific skills, step-specific direction/guidance, prospective entrustment), and 3) transferable attributes (e.g. general skills, team management, and operative plan). Assessment of the case difficulty, the surgical timeout quality, and an open-ended feedback item are also included.

Data collection and analysis

We pilot tested these six SEPAs evaluation instruments between April and September 2018 through convenience sampling. The attending surgeon, resident and a consistent 3rd surgeon-observer completed the same online SEPAs evaluation for the observed surgical case within 3 days of each evaluated operation via the Qualtrics system (SAP SE, Provo, UT). To reduce potential cognitive biases, we did not provide rater training for attending surgeons, residents, and the observer. We interviewed participants via convenience sampling to examine the extent that their thought process aligned with our intended SEPAs construct then refined the instrument until it aligned with participants' thought processes. Internal consistency (Cronbach's alpha) and temporal stability (test-retest reliability) were examined. We assessed criterion validity and construct validity, using descriptive statistics and factor analysis[8,9] via JMP Pro (version 13; SAS Institute Inc, Cary, NC).

Results

During the study period, 40 surgical cases from the 6 SEPAs procedures (laparoscopic cholecystectomy, laparoscopic inguinal hernia, open inguinal hernia, laparoscopic ventral hernia, open ventral hernia, and laparoscopic colectomy) performed by 10 chief residents with 11 attending surgeons were observed and evaluated. All residents (100%) discussed their case-specific learning goal with the attending surgeon prior to the case and provided self-reflection in the evaluation form at the end. The 3rd surgeon observer completed written feedback in all evaluations (100%) and the attending surgeons provided written feedback in 22 out of 40 cases (55.0%).

Validity

The SEPAs instruments were supported by strong validity evidence. Prospective resident OR entrustment scores strongly correlated with step-specific guidance (Pearson $r = 0.72$, $p < 0.0001$), followed by overall guidance ($r = 0.67$, $p < 0.0001$), procedure-specific performance ($r = 0.63$, $p < 0.0001$), overall performance ($r = 0.58$, $p < 0.0001$), achieved learning goal ($r = 0.52$, $p < 0.0001$), and general skills ($r = 0.51$, $p < 0.0001$). Moderate correlation was observed between prospective resident entrustment and team management ($r = 0.50$, $p < 0.0001$) as well as operative plan and judgment ($r = 0.34$, $p < 0.0001$). Case difficulty slightly limited prospective resident entrustment in the OR ($r = -0.31$, $p = 0.011$).

Factor analysis of the 12 SEPAs evaluation items revealed three factors with eigenvalues above 1.0, accounting for 58.4% of the total variance of resident SEPAs performance in the study sample (Table 1). Fig. 1 illustrates the factor loading for each SEPAs item. Items with factor loadings greater than 0.65 were considered the variables with strongest association to the three underlying latent variables, which were descriptively labelled as following: Factor 1 as *procedure-specific autonomy and entrustment* (3 items loaded on); Factor 2 as *global operative competencies* (3 items loaded on); Factor 3 as *resident learning efficacy* (2 items loaded on). These latent variables are in line with the core components of the SEPAs instruments - learning attributes, procedure-specific attributes, and transferable attributes – and supported by the entrustment evidence we reported previously.[5–7] Significance testing indicated three factors were sufficient ($p = 0.0048$) for these data and no additional factor might exist.

Reliability

Table 2 lists the internal consistency (Cronbach's alpha) and temporal stability (test-retest reliability) of the SEPAs evaluation instruments. Internal consistency of the SEPAs instruments was high with Cronbach's α ranging from 0.84 to 0.94 across the six procedures. Test-retest reliability, which was computed using the data extracted from residents who had two sets of SEPAs evaluation data from an identical procedure with a similar case difficulty level as well as the same attending surgeon, was strong (ranging from 0.74 to 0.93) in three available procedures.

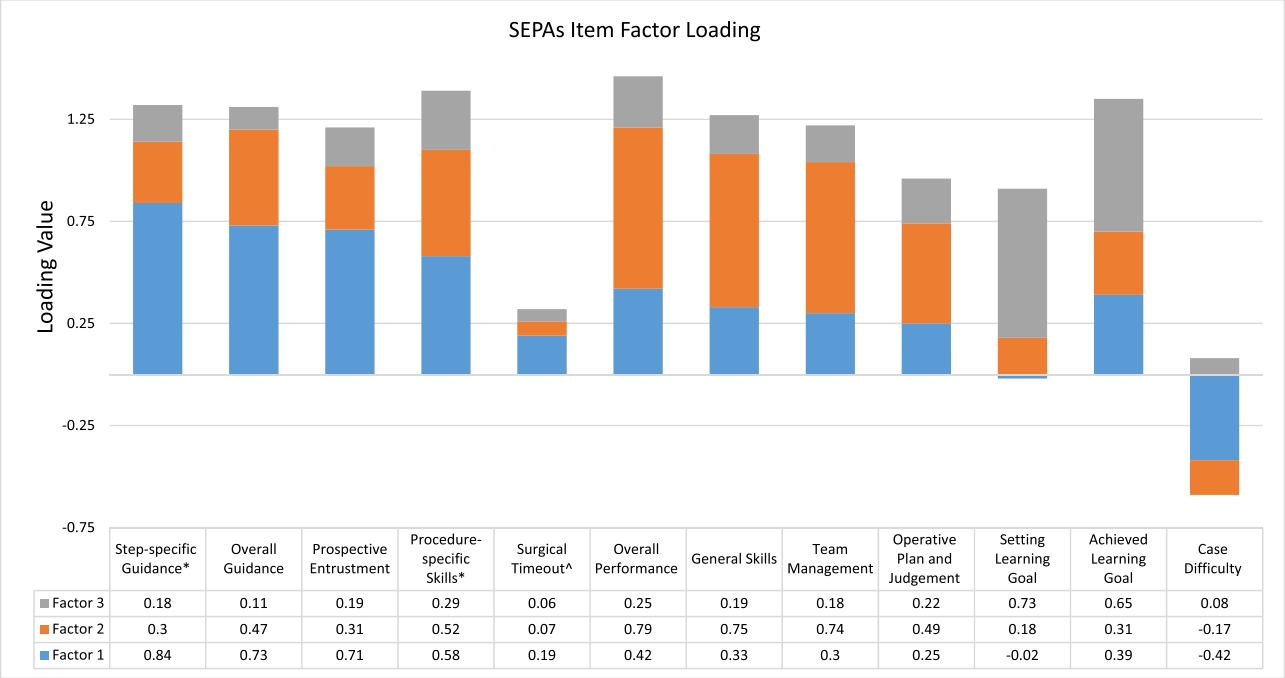
Discussion

Surgical residency training occurs within a highly dynamic and high-risk operative setting. Traditional resident operative performance evaluations, such as OPRS, mainly focus on technical performance that is part of core evidence supporting surgeons' assessment of resident entrustment and autonomy.[5,6] Attending surgeons usually determine whether to entrust resident with operative autonomy based on individual expert judgement of procedure-specific ad hoc entrustment evidence.[6] However,

Table 1
Variance explained by each factor.

Factor	Variance	Percent	Cumulative Percent
Factor 1	2.88	24.03	24.03
Factor 2	2.81	23.40	47.43
Factor 3	1.32	10.98	58.41

Note: Factor 1 - procedure-specific autonomy and entrustment; Factor 2 - global operative competencies; Factor 3 - resident learning efficacy.



	Step-specific Guidance*	Overall Guidance	Prospective Entrustment	Procedure-specific Skills*	Surgical Timeout^	Overall Performance	General Skills	Team Management	Operative Plan and Judgement	Setting Learning Goal	Achieved Learning Goal	Case Difficulty
Factor 3	0.18	0.11	0.19	0.29	0.06	0.25	0.19	0.18	0.22	0.73	0.65	0.08
Factor 2	0.3	0.47	0.31	0.52	0.07	0.79	0.75	0.74	0.49	0.18	0.31	-0.17
Factor 1	0.84	0.73	0.71	0.58	0.19	0.42	0.33	0.3	0.25	-0.02	0.39	-0.42

Fig. 1. SEPAs Item Factor Loading. Note: * Mean of all step-specific guidance/skill items. ^ Sum of all five timeout items. Factor 1 - procedure-specific autonomy and entrustment; Factor 2 - global operative competencies; Factor 3 - resident learning efficacy.

Table 2
Reliability of SEPAs.

Procedure	# of Case*	Cronbach's α	Test-Retest Reliability
Laparoscopic cholecystectomy	10	0.93	0.74 over a 3-week period
Laparoscopic colectomy	9	0.86	N/A
Laparoscopic ventral hernia	8	0.84	0.93 on the same day
Open ventral hernia	6	0.94	0.89 over a 5-week period
Open inguinal hernia	4	0.93	N/A
Laparoscopic inguinal hernia	3	0.84	N/A

Note: * Each case was evaluated by the attending surgeon, the resident, and a 3rd surgeon observer.

experts do not always agree.[10] In addition, contextual factors and personal factors[6] limit the transferability of an attending surgeon's entrustment of a resident across different cases. Thus, we developed new procedure-specific SEPAs evaluation instruments that include most of the core entrustment evidence manifested in the OR. The goal was to provide an additional tool to allow surgery residency programs to prospectively assess, review and accelerate acquisition of resident surgical competencies and development of prospective autonomy.

The correlations between prospective resident entrustment and step-specific guidance, overall guidance, procedure-specific performance as well as overall performance indicate that resident performance in present surgical cases predicts resident entrustment in future similar surgical cases. In particular, the less step-specific OR guidance that was observed during a recently completed case, the more entrustment would be expected in the next similar case that might consequently enable more resident autonomy in the OR. These findings are supported by our test-retest reliability and the literature that resident operative performance quality is an important determinant in attending surgeon decisions regarding resident entrustment and autonomy.[5,11] High test-retest reliabilities very likely indicate a consistency between attending surgeons' ratings of prospective resident entrustment and their subsequent related actions in similar future cases. The SEPAs evaluations thus demonstrate great potential in helping attending surgeons be aware of their expectations for a resident in upcoming similar cases, and then adjust their OR teaching plan correspondingly. Additionally, together with the relationship between case difficulty and prospective resident entrustment ($r = -0.31$, $p = 0.011$), our findings further verified previous study findings that procedure attributes and contextual factors had a considerable impact on surgeons' determinations of resident entrustment and autonomy in the OR.[6,7,12]

Factor analysis revealed the latent variables of *procedure-specific autonomy and entrustment* and *global operative competencies* could provide a similar percentage of observed resident SEPAs performance variance (Table 1). This finding suggests resident surgical entrustable professional activities are procedure-specific and built upon transferable surgical competencies. To be entrusted with autonomy to perform a surgical case independently, residents would likely need to meet three criteria: 1) minimal guidance was needed in the past similar case; 2) performance quality was excellent in the past similar case; 3) increased entrustment is granted in future similar cases.

Each surgical procedure by nature has two sets of intrinsic operative skills: primary skills that are specific to a given procedure and general skills that are applicable across procedures. The validated OPRS instrument provides evidence to assess resident medical knowledge and technical performance in procedure-specific and general domains. However, surgical faculty tend to

use evidence from other resident characteristics (e.g. training level, personal effort, learning ownership) to evaluate resident OR entrustment and autonomy as well.[5–7] As such, we included two specific learning goal items related to the procedure being evaluated (establishing a specific learning goal and achieving the learning goal) in the SEPAs instruments to meet this need. Findings from our study confirmed that resident learning efficacy was one of the critical factors contributing to resident SEPAs performance assessment. Interestingly, prospective resident entrustment was strongly associated with the extent of achieving the learning goal ($r = 0.52$, $p < 0.0001$), but not with the act of establishing a specific learning goal alone ($r = 0.15$, $p = 0.22$) in the study sample. One possible reason might be attending surgeons place more value on whether residents are able to execute their plan and achieve the defined learning goal. Hence, successfully achieving the learning goal would likely contribute more to prospective resident entrustment than establishing a well-defined specific learning goal alone.

We also observed that only 55% of attending surgeons in our study provided written feedback for residents. Thus, there is an opportunity for faculty development to enhance attending surgeons' awareness and skill in using actionable written feedback to facilitate the development of progressive resident entrustment in the OR.[13]

Our study is not without limitations. We were only able to report the test-retest reliability for 3 out of 6 SEPAs procedures in the current study sample. Although three existing test-retest reliabilities represent both open and laparoscopic procedures and were measured over various time spans, future study is needed to examine the test-retest reliability of laparoscopic inguinal hernia, open inguinal hernia, and laparoscopic colectomy. In the next phase of our research, we will further explore the feasibility and the effectiveness of this instrument in different residency and/or fellowship programs as a meaningful extension of current study.

Conclusions

The SEPAs instruments employed in this study are reliable and valid tools for assessment of crucial aspects of resident learning and surgical entrustable professional activities. They provide multifaceted evidence that is useful for programs and participants to prospectively assess, review and accelerate resident acquisition of surgical competencies that lead to entrustment and eventually surgical autonomy.

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Competing interest

The authors declare they have no competing interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amjsurg.2019.08.026.

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