Oregon Health & Science University
School of Medicine

Scholarly Projects Final Report

Title *(Must match poster title; include key words in the title to improve electronic search capabilities.)*

> A Programmatic System for Competency Assessment in Anesthesiology: Addressing ACGME Milestones

Student Investigator's Name

Date of Submission *(mm/dd/yyyy)*

Graduation Year

Project Course *(Indicate whether the project was conducted in the Scholarly Projects Curriculum; Physician Scientist Experience; Combined Degree Program [MD/MPH, MD/PhD]; or other course.)*

> Scholarly Projects Curriculum

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Concentration Lead's Name

Project/Research Question

A committee of experts on anesthesia education had previously developed a set of procedural assessments and 20 entrustable professional activities (EPAs) for use by anesthesiology residency programs for competency assessment. The EPAs and procedural assessments have been mapped to ACGME anesthesiology milestones. The current assessments do not cover the entire set of ACGME milestones (now milestones 2.0) and could therefore not be used as a comprehensive competency assessment system for anesthesiology residencies. The aims of this project were: 1) Revise the existing EPAs and procedural skills assessments based on the release of the ACGME 2.0 milestones for anesthesiology, 2) Develop assessment tools for anesthesiology milestones not covered by the EPAs and procedural assessments, 3) Implement the new assessments in the mobile app and web-based assessment system.

Type of Project *(Best description of your project; e.g., research study, quality improvement project, engineering project, etc.)*

Key words *(4-10 words describing key aspects of your project)*

Meeting Presentations
If your project was presented at a meeting besides the OHSU Capstone, please provide the meeting(s) name, location, date, and presentation format below (poster vs. podium presentation or other).

1. International Anesthesia Research Society (IARS), Virtual, May 13-16 2021, Poster
2. Western Anesthesia Residents Conference (WARC), Virtual, May 1 2021, Poster

Publications *(Abstract, article, other)*
If your project was published, please provide reference(s) below in JAMA style.

Not yet published

Submission to Archive

Final reports will be archived in a central library to benefit other students and colleagues. Describe any restrictions below (e.g., hold until publication of article on a specific date).

None

Next Steps

What are possible next steps that would build upon the results of this project? Could any data or tools resulting from the project have the potential to be used to answer new research questions by future medical students?

The major next steps for this project include 1) pilot and assess validity by comparing milestone achievement after assessment completion to Clinical Competency Committee determinization of milestone achievement for residents at varying levels of training 2) rolling out the system of assessments on a broad scale to all residency programs who wish to participate. Both of these next steps have been initiated already and will be completed by the core research team, including myself. One idea for a future project/spin off would be to analyze the first 6 months/1year of data that comes through MyTipReport and gather more feedback after validity is tested and the rollout is complete.

Please follow the link below and complete the archival process for your Project in addition to submitting your final report.

https://ohsu.ca1.qualtrics.com/jfe/form/SV_3ls2z8V0goKiHZP

Student's Signature/Date *(Electronic signatures on this form are acceptable.)*
This report describes work that I conducted in the Scholarly Projects Curriculum or alternative academic program at the OHSU School of Medicine. By typing my signature below, I attest to its authenticity and originality and agree to submit it to the Archive.

X _____
Student's full name

Mentor's Approval *(Signature/date)*

X _____
Mentor Name

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Report: Information in the report should be consistent with the poster, but could include additional material. Insert text in the following sections targeting 1500-3000 words overall; include key figures and tables. Use Calibri 11-point font, single spaced and 1-inch margin; follow JAMA style conventions as detailed in the full instructions.

Introduction *(≥250 words)*

Competency-based medical education (CBME) is a learner-centered and outcomes-based framework to foster trainees' growth towards independent practice[1]. The Accreditation Council for Graduate Medical Education (ACGME) initiated CBME in United States Graduate Medical Education (GME) by defining six core competencies designed to encompass all medical specialties[2]. The ACGME charged each specialty community with developing a set of milestones to help guide progress through the competencies[2]. The ACGME in conjunction with the Anesthesiology Residency Review Committee introduced Anesthesiology specific milestones in 2014. They describe the knowledge, skills, and attitudes within each sub-competency that are formative in the development of anesthesiology learners[3]. The ACGME has specified program directors must assess resident performance on the milestones to determine preparedness for graduation[4].

The actual implementation of milestones has been challenging for residency programs[2,5,6]. The milestones themselves were not meant to be assessment tools, and one of the key challenges for programs has been to develop tools for the assessment of milestone achievement. Direct observation during clinical care, assessment forms, and multisource feedback were the most universally suggested assessment tools by the Milestone Guidebook, but no universal assessments were defined by the ACGME[2].

Workplace-based assessments like entrustable professional activities (EPAs), that are focused on core clinical activities, have been well received by faculty as effective assessment tools. In 2018, a committee of national experts on anesthesia education developed a core set of entrustable professional activities (EPAs) and procedural assessments to evaluate and document United States anesthesiology resident achievement of milestones[7] (Table 1). Different levels of competency (trust) in the EPAs and procedural skills were mapped to the ACGME anesthesiology milestones, thus these assessments directly linked meaningful clinical activities to milestone competency assessment. The EPAs and procedural assessments were implemented in a mobile and web-based application to gather assessments that could display development of competency in EPAs and procedural skills. The application provided a summary view of milestone achievement that could be used by program directors (PDs) and clinical competency committees (CCCs) to make final determinations of milestone achievement for reporting to the ACGME[7]. During the development of the EPAs and procedural skills assessments, the authors found that several milestones were not adequately addressed by these core clinical assessments. In particular, gaps existed in the sub-competencies of Interpersonal and Communication Skills (ICS), Practice-Based Learning and Improvement (PBLI), Professionalism (P), and Systems-Based Practice (SBP)[7]. The ACGME and others have described the need for a "programmatic system of assessment" that utilizes a combination of different assessment methods and tools to address all the milestones [8,9]. Programmatic systems of assessment have been developed for surgery and emergency medicine, but not for anesthesiology[10,11].

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Methods *(≥250 words)*

This study was approved by the Institutional Review Board of Oregon Health and Science University (IRB #18828). Informed consent was obtained from the survey participants. This study adheres to the applicable Standards for Reporting Qualitative Research (SRQR) guidelines for reporting qualitative research.

All but one member of a convenience sample of 18 experts in education, competency assessment, and EPAs previously recruited in the prior investigation agreed to participate in this study[7]. Two new members were added to the steering committee (ZG, TH) and five new experts (MA, GB, NC, RI, ERP) were added to the expert panel resulting in twenty-four education experts from fourteen programs participating in the study. Three participants hold doctorate degrees in education (FC, AMJ, SM), thirteen have published in the area of education research and competency assessment (AA, FC, RM, SAM, AMJ, AM, BM, PT, WVC, GW, JM, RI, MA), seven are anesthesiology residency program directors (AA, MD, MH, BL, MA, JD, GB), one is the US liaison to the International Anesthesiology Competency-based Medical Education Committee (GW), and one is involved in EPA implementation in the European Union and also a member of the International Anesthesiology Competency-based Medical Education Committee (AM). A four-member steering committee was responsible for facilitating the flow of the investigation (ZG, TH, GB, GW).

Revision of EPAs based on the Release of the Anesthesiology 2.0 Milestones

The 2.0 milestones were extensively revised and included additions, deletions, and changes to the sub-competencies and milestones within each sub-competency. The steering committee revised the mapping of EPA and procedural skill entrustment to the new milestones. The revised maps presented to the expert panel for review and comment. Following revisions, the expert panel approved the new milestone maps.

Milestone Gap Analysis

An analysis was performed by the planning committee to identify which 2.0 milestones were not addressed by the EPAs and procedural assessments (i.e., none of the EPAs or procedural skills assessed the milestone).

Identifying Assessments to Address Milestone Gaps

The expert panel participated in a modified Delphi process to suggest and revise a set of new assessments that could address the milestone gaps. Each round consisted of panel suggestions, steering committee review to revise suggestions (e.g., eliminate duplicates, consolidate similar items, standardized descriptions), panel voting and comment on the list, and steering committee review and reporting of results of the round. The iterative development of new assessments followed a formalized process (Figure 1).
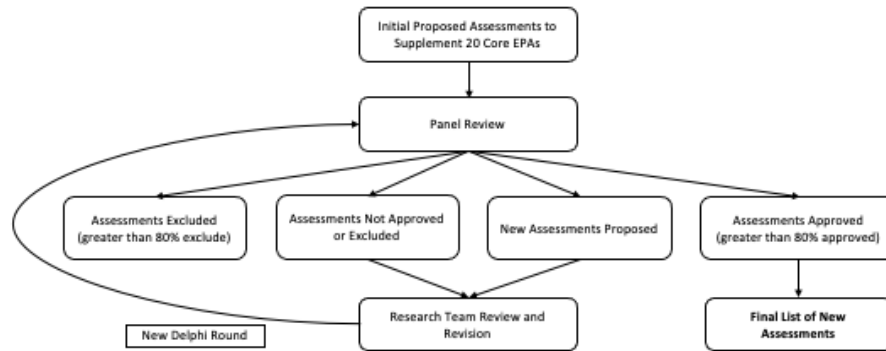
Figure 1. The modified Delphi process used to reach consensus on new assessments for the ACGME Anesthesiology 2.0 Milestones. The cutoff for group consensus used throughout the study was eighty percent approval.

Defining Assessments and Milestone Mapping

        Individual expert panel members were solicited to develop assessments. Panel members were provided templates and instructions based on the type of assessment assigned to them. For example, panel members tasked with developing Objective Structured Clinical Examinations (OSCEs) were provided a steering committee approved example OSCE and an OSCE template developed by experts in OSCE development from the University of North Carolina Department of Anesthesiology. Panel members defining new EPAs referred to prior developed EPA definitions and the Association of American Medical Colleges toolkit for developing and defining EPAs[12]. The full assessment definitions included background information, learning objectives, and examples of required behaviors and skills. Once all definitions were complete, a modified Delphi process was used to revise and approve the definitions. Once consensus on the definitions was reached, the planning committee mapped the new assessments to the 2.0 milestones. The mappings were revised based on panel comments until consensus was reached.

Iteration of Process

        Once a consensus on a new set of assessments and their milestone mapping was reached, a new gap analysis was performed by the steering committee. Results were presented to the expert panel and the process of suggesting new assessments, defining the assessments, and mapping them to milestones was repeated.

Technical Implementation

        The developed assessments can be implemented in a variety of software platforms. For the purpose of this study, all EPAs, Situational Assessments, and OSCEs were implemented in a mobile app and web-based application from MyTipReport, (MyTipReport LLC, Richmond, VA) as a matter of convenience. Users of MyTipReport are allowed to use any of the assessments developed by the panel. They may also modify them, delete them, or create their own. The app and website allow faculty to select a trainee, select a specific assessment, and submit an assessment grade in real time. No funding was provided by MyTipReport for the conduct of this study.

Statistical Analysis

        All analyses were performed with Microsoft Excel (Redmond, WA). Survey results were analyzed with descriptive statistics using mean values. Milestone coverage of the original assessments was

compared to complete milestone coverage of final new assessments by summing data and calculating proportional coverage of all anesthesiology milestones.

Results *(≥500 words)*

Gap analysis of the core EPAs and procedural assessments revealed 68.5% coverage of the Anesthesiology 1.0 Milestones. 88 milestones were left uncovered. A heat map was developed to visualize deficiencies in specific sub-competencies (Figure 2). There was an evident lack of milestone coverage in the areas of: patient safety, quality improvement, commitment to institution and colleagues, feedback, and maintenance of personal health.

		1 PreOp Assess	2 PeriOp Care	3 PACU	4 Transfer of Care	5 Out of OR	6 Airway	7 Labor Anesth	8 C-Section	9 Pregnant NonOB	10 Peds	11 Neonate	12 Cardiac	13 Thoracic	14 Critical Care	15 Acute Pain	16 Regional Anesth	17 Chronic Pain	18 Intra-Cranial	19 Trauma	20 AAA	Percentage of all subcompetencies represented by EPAs
PC1	Evaluatiojn & Assessment	0.93	0.73	0.33	0.27	0.87	0.87	1.00	0.93	1.00	1.00	1.00	1.00	1.00	0.13	0.13	1.00	1.00	1.00	1.00	1.00	1.00
PC2	Anesthetic Plan	0.55	0.64	0.18	0.00	1.00	0.73	0.91	1.00	0.82	0.82	0.82	0.82	0.82	0.18	0.18	0.82	0.27	0.82	1.00	0.82	1.00
PC3	Procedural Pain Management	0.00	1.00	1.00	0.00	0.83	0.00	1.00	1.00	0.67	1.00	1.00	1.00	1.00	0.33	0.83	1.00	1.00	1.00	1.00	1.00	1.00
PC4	Complication Management	0.00	0.80	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PC5	Crisis Management	0.00	0.40	1.00	0.00	0.80	1.00	0.40	0.60	0.40	0.40	0.40	0.40	0.40	1.00	0.00	0.40	0.00	0.40	1.00	1.00	1.00
PC6	Critically Ill Management	0.00	0.00	1.00	0.17	0.92	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.00	0.00	0.00	0.00	0.00	0.00	1.00
PC7	Acute / Chronic Pain Management	0.00	0.29	0.71	0.00	0.14	0.00	0.29	0.29	0.21	0.29	0.29	0.29	0.29	0.29	0.79	0.71	1.00	0.29	0.21	0.29	1.00
PC8	Skills: Airway Management	0.00	0.45	0.09	0.00	0.82	1.00	0.09	0.73	0.64	0.55	0.45	0.73	0.55	0.00	0.36	0.00	0.45	1.00	1.00	0.45	1.00
PC9	Skills: Monitoring & Equipment	0.00	0.94	0.13	0.00	1.00	0.31	0.44	0.44	0.75	1.00	0.94	1.00	1.00	0.94	0.00	0.31	0.00	1.00	1.00	1.00	1.00
PC10	Skills: Regional Anesthesia	0.00	0.00	0.00	0.00	0.93	0.00	0.73	0.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00
MK1	Medical Knowledge	0.09	0.09	0.09	0.00	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
SBP1	Coordination of Care	0.00	0.20	0.80	0.10	0.30	0.20	0.60	0.70	0.30	0.30	0.30	0.30	0.30	0.70	0.70	0.80	0.80	0.30	0.50	0.40	0.90
SBP2	Patient Safety / Quality Improvement	0.00	0.24	0.48	0.10	0.43	0.43	0.33	0.48	0.24	0.24	0.24	0.24	0.24	0.52	0.00	0.43	0.29	0.24	0.33	0.33	0.76
PBLI1	Patient Safety / QI Initiatives	0.00	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.00	0.33	0.33	0.33	0.33	0.33	0.50
PBLI2	Practice Improvement	0.00	0.09	0.09	0.00	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.00	0.36	0.55	0.09	0.09	0.09	0.64
PBLI3	Self-directed Learning	0.00	0.45	0.00	0.00	0.55	0.55	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.55	0.00	0.55	0.55	0.45	0.45	0.45	0.55
PBLI4	Patient Education	0.00	0.40	0.30	0.00	0.50	0.50	0.40	0.50	0.50	0.50	0.50	0.50	0.50	0.30	0.90	0.50	0.50	0.50	0.50	0.50	0.90
P1	Responsibility to patients & others	0.00	0.60	0.53	0.00	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.87	0.67	0.60	0.60	0.60	0.67	0.93
P2	Honesty, Integrity, Ethical Behavior	0.00	0.57	0.14	0.14	0.29	0.29	0.71	0.57	0.29	0.57	0.57	0.57	0.57	0.57	0.00	0.57	0.57	0.57	0.71	0.71	0.86
P3	Commitment to Institution & Colleagues	0.00	0.14	0.29	0.00	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.00	0.14	0.14	0.14	0.14	0.14	0.29
P4	Receiving & Giving Feedback	0.00	0.29	0.00	0.00	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.00	0.43	0.43	0.29	0.29	0.29	0.43
P5	Maintenance of Personal Health	0.00	0.07	0.00	0.00	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.00	0.07	0.07	0.07	0.07	0.07	0.07
ICS1	Communication with Patients & Families	0.05	0.37	0.63	0.00	0.42	0.47	0.37	0.47	0.37	0.37	0.37	0.37	0.37	0.47	0.63	0.47	0.53	0.37	0.37	0.42	0.74
ICS2	Communication with Professionals	0.06	0.44	0.56	0.56	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.88	0.50	0.50	0.50	0.50	0.56	1.00
ICS3	Team & Leadership Skills	0.00	0.89	0.78	0.44	0.89	0.78	0.67	0.89	0.89	0.89	0.89	0.89	0.89	1.00	0.00	0.89	1.00	0.89	0.89	0.89	1.00

ACGME Competencies (row group label, left margin)

Heatmap Key: 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00

Figure 2. Heat map demonstrating proportion of Anesthesiology 1.0 Milestone achievement for each ACGME sub competency after simulated completion of all core EPA and procedural assessments.

Specific milestones and milestone themes not addressed by the core assessments included:

ICS 1
- Negotiating patient and family conflicts, Root cause analysis, Disclosure of medical errors

ICS 2
- Conflict resolution, Communication in crisis

ICS 3
- Participation in team-based conference related to patient care

PBLI 1
- Develops personal quality improvement plan, Carries out a QI Project

PBLI 2
- Identifies adverse events and develops a plan to address them, Analyzes personal practice for potential risk, Develops plan to minimize risk, Analyzes personal performance outcomes, Uses benchmark data for self and group

PBLI 3
- Develops a learning plan, modifies plan, Evidence-based medicine, Analyze personal practice to focus self-directed learning

PBLI 4
- Teaching students, residents, other health professionals

Prof 1

- Meets needs of diverse population

Prof 2
- Truthful, Addresses ethical issues and dilemmas

Prof 3
- Complies with institutional policies, Completes evaluations, Volunteers to assist with coverage, Mentorship

Prof 4
- Feedback and lifelong learning

Prof 5
- Knowledge of wellness issues, Demonstrates balance, Complies with policies to support wellbeing, Reinforces concepts and policies to junior colleagues, Physician Impairment

SBP 1
- Caring for multiple patients, System resources for nonsubspecialty care

SBP 2
- Participates in team-based safety, Participates in institutional safety, Identifies safety issues, participates in QI project, Participates in QI, Root cause analysis, Incorporates national standards

The modified Delphi process to identify and define assessments to address milestone gaps, as well as cover updates and changes based on the release of Anesthesiology Milestone 2.0, was repeated rigorously until the expert committee reached consensus a group of new assessments. New assessment types (OSCEs and Situational Assessments) were added to the system for their dynamic ability to address unique, non-clinical scenarios. Ultimately, twenty-two assessments were agreed upon (Table 1).

Table 1. New EPAs, OSCEs, and Situational Assessments		
EPAs	**OSCEs**	**Situational Assessments**
EPA 21: Post-op Follow Up	OSCE 1: Adverse Event	SA 1: Leadership of quality/safety initiative
EPA 22: Leadership and Management of a Team	OSCE 2a: Patient Conflict	SA 2: Review of personal outcomes and reflective practice
EPA 23: Perioperative Care of Patient with Substance Use Disorder or Chronic Pain	OSCE 2b: Patient and Family Conflict	SA 3:Receiving feedback
EPA 24: Management of Uncommon and Rare Events	OSCE 3: Staff Conflict	SA 4: Teaching and presenting
EPA 25: Management of Perioperative Complications	OSCE 4a: Ethical Issue - Consent	SA 5: Crisis management
	OSCE 4b: Ethical Issue - End of Life Care	SA 6: Clinical reasoning
		SA 7: Evidence-based medicine
		SA 8: Adapting care for different populations
		SA 9: Managing conflict

		SA 10: Managing ethical issues
		SA 11: Professionalism, accountability, and wellness

Full definitions varied by assessment type, but included learning objectives, examples of appropriate use, scripts, grading sheets, and milestones mapped to specific behaviors when appropriate (Figure 3).

Relevant Milestone	Most EPAs will be relevant to several ACGME Anesthesiology Milestones. Each milestone has a code - e.g PC 3 stands for Patient Care (the competency) 3 (the subcompetency peri-procedural pain). Within the subcompetency are a number of milestones. Each entrustment level within and EPA will correspond to a different milestone. List only the subcompetencies relevant to the EPA here	EPA Entrustment Level (Simple)					EPA Entrustment Level (Complex)				
CODE	List of Subcompetencies and Milestones (check all that apply to each level of entrustment)	Did Activity Supervisor did the acitvity	Direct Supervision constant or near constant supervision, requires physcial presence	Reactive Supervision Supervisor directed trainee from time to time, trainee often requires consultation	Available if Needed Supervisor was available just in case, reactive supervision that is infrequent	Independent Practice Trainee ready for independent practice	Did Activity Supervisor did the acitvity	Direct Supervision constant or near constant supervision, requires physcial presence	Reactive Supervision Supervisor directed trainee from time to time, trainee often requires consultation	Available if Needed Supervisor was available just in case, reactive supervision that is infrequent	Independent Practice Trainee ready for independent practice
	Patient Care 1: Pre-anesthetic patient evaluation										
PC 1 - L1 - 1	Performs basic chart review										
PC 1 - L1 - 2	Conducts patient interview with direct supervision										
PC 1 - L1 - 3	Conducts and interprets a physical examination, with direct supervision										
PC 1 - L2 - 1	Performs focused chart review, with indirect supervision										
PC 1 - L2 - 2	Interviews the patient and gathers pertinent information, with indirect supervision										
PC 1 - L2 - 3	Conducts a focused physical examination, with indirect supervision										
PC 1 - L3 - 1	Interprets chart review information to assess need for further work-up										
PC 1 - L3 - 2	Interprets information collected during patient interview, with assistance										
PC 1 - L3 - 3	Identifies comorbidities on physical examination that may require further evaluation, with indirect supervision supervision										
PC 1 - L4 - 1	Evaluates diagnostic data and provides risk stratification based on comorbidities and anesthetic implications										
PC 1 - L4 - 2	Independently identifies the need for additional evaluation and suggests therapeutic interventions										
PC 1 - L4 - 3	Independently identifies concerning physical exam findings that require further evaluation										
PC 1 - L5 - 1	Independently identifies a previously undiagnosed condition										
	Interpersonal and Communications Skills 1: Patient- and Family-Centered Communication										
IC1 - L1- 1	Communicates with patients and their families in an understandable and respectful manner	x	x	x	x		x	x	x	x	
IC1 - L1- 2	Provides timely updates to patients and patients' families										
IC1 - L2- 1	Customizes communication in the setting of personal biases and barriers with patients and patients' families										
IC1 - L2- 2	Actively listens to patients and patients' families to elicit patient preferences and expectations		x	x	x			x	x	x	
IC1 - L3- 1	Explains complex and difficult information to patients and patients' families							x	x	x	
IC1 - L3- 2	Uses shared decision making to make a personalized care plan		x	x	x			x	x	x	
IC1 - L4- 1	Facilitates difficult discussions with patients and patients' families										
IC1 - L4- 2	Effectively negotiates and manages conflict among patients, patients' families, and the health care team										
IC1 - L5- 1	Mentors others in the facilitation of crucial conversations										
IC1 - L5- 2	Mentors others in conflict resolution										

Figure 3a) Screenshots from EPA21 showing entrustment levels of milestones that may be achieved after completing EPA21. The comprehensive list of Anesthesiology Milestones 2.0 fills the first column (this is a small snapshot of the comprehensive list) and an "x" denotes milestone achievement within the assessment.

OSCE 1: Adverse Event

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University of Wisconsin-Madison

Disclosures: None

Learning Objectives:
Upon completion of this activity, the participant is expected to be able to:

- Communicate medical errors or complications, including potential causes and outcomes, as well as plans for further evaluation and treatment.
- Respond to questions from the patient's family using lay terms.
- Demonstrate understanding of and empathy for the patient's situation.

OSCE: You are an anesthesia attending. Your patient is unexpectedly admitted to the ICU after you accidentally administered vasopressin instead of ondansetron to the patient at the conclusion of a laparoscopic cholecystectomy, resulting in a hypertensive crisis. The patient is currently intubated and sedated in the ICU after receiving multiple antihypertensive agents. A head CT performed postoperatively demonstrated a small subarachnoid hemorrhage. The patient's partner is waiting to speak with you regarding this medication error and the resulting complication.

Script				Grading Sheet and Milestone Mapping				
"Communication with Patients and Families" – Interpersonal and Communication Skills 1			Setting: ICU waiting room	Milestone Level	Milestone Rubric (for grading)	Specific Action or Behavior	Achieved (Y/N)	Evaluation Comments
State	Participant	Actor Role = Patient's spouse	Room Setup					
Initial Interaction	Participant enters room and introduces self to the patient's spouse	"Hello doctor. Thank you for coming to see me. What is going on? Why is my husband/wife/partner in the ICU? What happened?"		Entry	ICS1-L1-1 Communicates with patients and families in an understandable and respectful manner	1. Acknowledge the patient's spouse's concern regarding the medication error and perioperative complication, demonstrating empathy for the patient and their family.		
Response 1	Participant explains the situation surrounding the patient's condition and medication error to the patient's spouse/partner. 1. Medications stocked incorrectly in drug tray 2. Wrong medication administered to patient resulting in hypertensive crisis 3. Failure to read medication label 4. Attempted to control blood pressure quickly 5. Results of head CT 6. Unknown neurologic status	Potential responses or follow-up questions from spouse depending on participant's explanation: 1. What medications were given incorrectly? 2. How did this happen? 3. What is going to happen to my husband/wife/partner now? 4. Will he/she/they wake up? 5. Is there something wrong with his/her/their brain? 6. Are there any other complications from this medication error? If the participant does not use lay terms to describe the situation, the			ICS1-L2-2 Actively listens to elicit questions and concerns ICS1-L1-2 Provides timely updates to patients and families SBP1-L2-1 Identifies system factors that lead to patient safety events	2. Describes the medication error and resulting hypertensive crisis to the patient's spouse including details surrounding the event. Asks for help as needed in communicating with family and assisting with follow-up		

Figure 3b) Screenshots from OSCE1 highlighting learning objectives, scripts, and grading sheets that were designed by the committee. Specific actions and behaviors are linked to specific milestones.

Special Assessment 1

Title: Contribution to or Leadership of Formal Institutional Quality and/or Safety Activities

Description: This special assessment is to be utilized when a trainee has the opportunity to engage in routine quality and safety practices OR contribute to or lead a formal quality or safety initiative.

Examples of engagement in routine safety activities include but are not limited to utilizing the safety features of devices, incorporating national safety standards into patient care, ensuring safe use of medications during patient care, knowing how to report patient safety events, or demonstrating knowledge of common events that affect patient safety.

Examples of institutional quality or safety initiatives include but are not limited to: Root Cause Analysis, continuous quality improvement meetings, and safety/quality policy development.

Throughout their training, residents encounter situations where patient safety or care quality has been compromised or is potentially compromised. This special assessment may be used in these situations to evaluate resident performance and engagement with formal quality or safety initiatives. This assessment should be used when trainees have the opportunity to demonstrate behaviors in the domains of Practice-based Learning and Improvement (PBLI) and Systems-based Practice (SBP) that relate to formal quality and safety initiatives as well as routine safety precautions. The assessment options are different levels of competency in skills in safety and quality improvement. The specific behaviors and corresponding milestones are as follows:

1. **Skills in reducing the risk of patient injury** (the items below are levels of successive levels of competency in teaching and presenting)

- **Demonstrated knowledge of common events that affect patient safety and participates in routine efforts to improve patient safety** (examples: knowledge of positioning injury, intraoperative hypotension risks, residual paralysis, corneal abrasion, wrong side block or procedures, and medication errors) **and** participates in routine institutional or team activities to promote patient safety (examples: procedure time-out, team communication, transfer of care checklist, etc.)
  - SBP1-L1-1 – knowledge of common events that impact patient safety
  - SBP1-L3-3 – Participates in department patient safety initiatives
- **Reports patient safety events through the institutional reporting system**
  - SBP1-L1-2 – Demonstrates knowledge of how to report patient safety events
  - SBP1-L2-2 – Reports patient safety events through institutional reporting system

Figure 3c) Screenshots from SA1 showing description, examples for use, and specific milestones that may be achieved after completion of a situational assessment where a trainee is leading or contributing to a quality or safety initiative.

Scholarly Project Final Report

Gap analysis of the programmatic set of assessments, including all EPAs and procedural assessments, SAs, and OSCEs, revealed 91% coverage of the Anesthesiology 2.0 Milestones. 25 milestones were left uncovered. A similar heat map was developed to visualize updated, and targeted sub competency coverage by the new assessments (Figure 4).
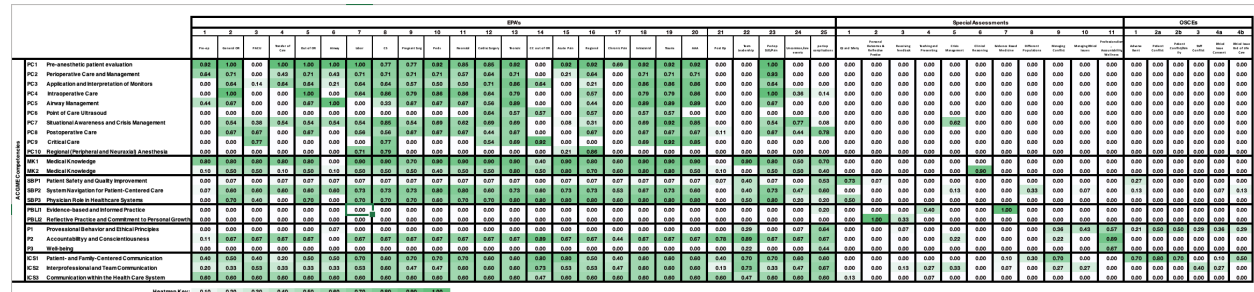
Figure 4. Heat map demonstrating proportion of Anesthesiology 1.0 Milestone achievement for each ACGME sub competency after simulated completion of all core EPA and procedural assessments.

Discussion *(≥500 words)*

The shift to competency-based medical education and the introduction of milestones by the ACGME has challenged educators with developing means to assess trainee competency[13]. CBME requires a robust framework that not only defines key competencies, but also meaningful tools to assess competency achievement and support learner growth[14]. Programmatic assessment has emerged as an educational pedagogy, centered around optimizing fit and purpose of assessments, that captures competence in a variety of educational settings. It has shifted assessment ideology away from a 'one size fits all' approach. Instead, programmatic assessment utilizes a variety of assessment methods, and multiple assessors across clinical settings, to maximize assessment *of* learning and *for* learning[15]. By design, programmatic assessment in medical education draws strength from its ability to provide high quality and high quantity of feedback to learners, support development of required skills, use assessment data for continuous quality improvement, and ultimately improve patient care[14].

In anesthesiology, the desired outcomes of training have been clearly defined by the ACGME through the publication of core competencies and milestones specific to the specialty[3]. The first step towards developing a programmatic assessment for anesthesiology residents was initiated by a group of anesthesia education experts from across the United States. After undergoing a rigorous process, this group developed a set of core entrustable professional activities and procedural assessments that are workplace-based means of recording milestone achievement and providing continual feedback to trainees[7]. While these assessments were targeted to address many of the core clinical performance markers of an anesthesiologist, these two types of assessments did not compose a true programmatic system for competency assessment. Many milestones were left uncovered, particularly in non-patient care sub competencies. Using milestone gaps to identify new means of assessment follows a core tenant of programmatic assessment – that assessment objectives should match educational objectives. It is critical that assessments be designed around these milestones[16]. The work completed in this study successfully targeted milestone gaps and intentionally provides a more robust system for competency assessment for anesthesiology trainees.

Many of the milestones left uncovered by the core EPAs and procedural assessments were non-patient care related. Some described trainee behaviors and actions in situations that may never be

encountered in residency (eg: participating in quality improvement projects, or managing interpersonal conflict). The committee reached consensus on developing two new types of assessments to address these specific milestone groups: OSCEs and Situational Assessments. Both of these strategies are highly conducive to assessing behaviors in specific scenarios. OSCEs are widely used along the medical educational continuum and are touted for their reliability and validity in testing performance. OSCEs are not only useful as assessment means, but also present valuable teaching opportunities. OSCEs have the potential to correlate well with traditional means of assessment for unique clinical scenarios[17-20]. Situational assessments are adjunct assessments which target milestones falling inbetween EPAs and OSCEs. All of the developed assessments can be edited by the individual programs, providing flexibility for all program's specific needs. The comprehensive set of assessments provides a multitude of opportunities to assess skills, behavior, and milestones expected of anesthesiology trainees along the educational continuum. These assessments further promote the disconnect between assessment moments and decision moments on competency that is key for programmatic assessment[14]. With these tools, faculty have the opportunity to provide meaningful feedback in a range of clinical microenvironments. With MyTipReport and the mobile app, the means to provide this feedback are at their fingertips.

There are a few key limitations to this study. First, a key component of programmatic assessment that has yet to be address is test validity. Future work from this committee will involve collecting assessment data from residency programs and correlating resident performance (achievement of milestones) yielded from these assessments with performance determined by clinical competency committees. The modified Delphi process provided this group with consensus on full assessment definitions, including milestone mapping, however this process is subjective to the relatively small sample of committee members. Not all milestones were able to be achieved by the programmatic system of assessments (Figure 4). The milestones left uncovered were predominately level five milestones, which this group defined as 'aspirational'. Many of these behaviors and skills are described at the fellowship level of competency, and would not necessarily be reasonably expected of resident trainees.

Conclusions *(2-3 summary sentences)*

21 assessments were developed and approved by a committee of experts in anesthesia education. The new assessments create a programmatic system and structured method to evaluate achievement of the over 90% of ACGME anesthesiology milestones. These new assessments primarily evaluate non-patient care sub-competencies that were not covered by the core EPAs and procedural assessments.

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