The Importance of Competency-Based Programmatic Assessment in Graduate Medical Education

Saroj Misra, DO, FACOFP
William F. Iobst, MD
Karen E. Hauer, MD, PhD
Eric S. Holmboe, MD, MACP, FRCP

The transition to competency-based medical education (CBME) began in earnest for accredited graduate medical education (GME) programs with the introduction of the Outcome Project in 2001.[1] In 2007, the Accreditation Council for Graduate Medical Education (ACGME) began exploring Milestones.[2] The Next Accreditation System (NAS) launched in 2013 with 3 core aims: strengthen the peer-review accreditation system to prepare physicians for practice in the 21st century, promote the transition to outcomes-based accreditation and medical education, and reduce the burden of traditional structure and process-based approaches.[3] The NAS implemented multiple major changes. First, the Milestones defined the 6 general competencies in developmental narrative terms. By 2014, almost all participating GME programs were required to submit semiannual resident Milestones evaluations within the accreditation process. Second, all programs were also required to implement clinical competency committees (CCCs) to use group-based decision-making for judging learner progress.[3]

Prior to the NAS launch, an international group in 2010 identified 4 overarching principles required for effective CBME: focus on outcomes of the educational process, emphasis on acquirable abilities, learner-centeredness, and deemphasis on time-based education.[4] van Melle and colleagues extended these principles with their CBME Core Components Framework.[5] This framework (TABLE 1) identifies 5 essential components for competency-based training programs medical educators must, ideally, address to implement CBME. TABLE 1 also provides gaps in implementation of these components and offers potential goals and approaches to close those gaps. While this discussion will focus on the fifth core component, programmatic assessment, each of these components is essential in implementing CBME.

DOI: http://dx.doi.org/10.4300/JGME-D-20-00856.1

Operationalizing the NAS continues to be a work in progress. The transition from a time-based model that relies on time and volume proxies to judge competence to an outcomes-based medical education remains a major challenge for the US GME system. The COVID-19 pandemic has further exposed many limitations of a time-based system and disrupted traditional faculty-learner interactions, time-based rotation schedules using fixed learning venues, and previously developed approaches to assessment. Prior to the pandemic, a number of studies showed significant gaps and variability in the assessments used to make decisions about the progression of their learners on the Milestones.[6,7] For example, in a study of 14 CCCs by Schumacher and colleagues, only one program reported using multisource feedback, and no programs reported using clinical performance data as part of their program of assessment.[8] The ACGME also released guidance last fall for assessment during the pandemic and highlighted the importance of programmatic assessment and the need to still assess all the competencies to ensure graduates are prepared for unsupervised practice.[9]

Due to the shifting landscape of training venues and individuals conducting direct observation (secondary to redeployment), assessment opportunities have become more challenging.[10–12] These new and evolving realities create an opportunity to redouble efforts to realize an outcomes-based GME system. To accelerate change, the GME system and the NAS need to further integrate the original 4 principles with the 5 core components of CBME. One essential area requiring heightened effort is programmatic assessment, essential to fully achieve the promise of outcomes-based education to meet the needs of the public. This perspective presents key aspects of successful programmatic assessment for residencies and fellowships, with a focus on newer concepts to enhance effectiveness.

TABLE 1
Core Components Framework for Competency-Based Medical Education (CBME)[a]

Component	Description	Perceived Gap(s)	Goals and Approaches
An outcomes-based competency framework	▪ Desired outcomes of training are identified based on societal needs. ▪ Outcomes are paramount, meaning a graduate's abilities to function as an effective health professional.	▪ Outcomes are often unclear or unique to the local needs of the program. ▪ Outcomes meet the arbitrary needs of the institution or program rather than standardized specialty outcomes.	▪ Medical curriculum must be developed to meet the needs of the health care system and the populations it serves. Medical curriculum must ensure that all graduates are prepared for unsupervised practice in all the essential competencies.
Progressive sequencing of competencies	▪ In CBME, competencies and their developmental markers must be explicitly sequenced to support learner progression from novice to master clinician. ▪ Sequencing must consider that some competencies form building blocks for the development of further competence. Progression is not always a smooth, predictable developmental curve.	▪ Competencies are not always explicitly identified and may not follow sequential development from foundational to more advanced elements. ▪ Current curricular structures are not well designed to support progressive sequencing of the core competencies.	▪ Programs should map specialty Milestones with curricular objectives to ensure all critical outcomes are taught (and assessed) in a developmental progression that promotes mastery learning. ▪ Curricular design and assessment programs must account for different rates of progression among learners.
Learning experiences tailored to competencies in CBME	▪ Time is a resource, not a driver. ▪ Learning experiences should be sequenced in a way that supports the progression of competence. ▪ There must be flexibility in order to accommodate variation in individual learner progression. ▪ Learning experiences should resemble the practice environment. ▪ Learning experiences should be carefully selected to enable acquisition of one or many abilities. ▪ Most learning experiences should be tied to an essential graduate ability.	▪ Time is seen as limiting factor for progression. ▪ Learning experiences may not reflect real-world opportunities or practice. ▪ Learners are grouped to provide streamlining of teaching (ie, all residents of the same training year get the same material at the same time, regardless of assessment of competency).	▪ Ensure that learning venues have clearly defined curricular outcomes that align and enrich the program's curriculum. ▪ Leaning experiences must prepare learners for unsupervised practice and allow for competency rather than time-based progression. ▪ Use individualized learning plans to help learners identify strengths and weaknesses and tailor learning on an ongoing basis.
Teaching tailored to competencies	▪ Clinical teaching emphasizes learning through experience and application, not just knowledge acquisition. ▪ Teachers use coaching techniques to diagnose a learner in clinical situations and give actionable feedback. ▪ Teaching is responsive to individual learner needs. ▪ Learners are actively engaged in determining their learning needs. ▪ Teachers and learners work together to solve complex clinical problems.	▪ Focus of teaching is on knowledge acquisition with application being limited both in scope and perspective. ▪ Teaching is unidirectional with the responsibility to improve solely that of the learner. ▪ Learners' goals are driven by teachers' competency and priority with little input from the learner and irrespective of societal need.	▪ Develop faculty development programs addressing competencies in: ▪ Feedbacktechniques that actively engage the learner. ▪ Coachingtechniques that promote self-regulated learning and development of individualized learning plans aimed at promoting the unique developmental needs of each learner. ▪ Assessmentinformed by "shared mental models" that are literature informed/evidence-based and criteria referenced.

TABLE 1
Core Components Framework for Competency-Based Medical Education (CBME)[a] (continued)

Component	Description	Perceived Gap(s)	Goals and Approaches
Programmatic assessment	▪ There are multiple points and methods for data collection. ▪ Methods for data collection match the quality of the competency being assessed. ▪ Emphasis is on workplace observation. ▪ Emphasis is on providing personalized, timely, meaningful feedback. ▪ Progression is based on documentation of achievement. There is a robust system for decision-making.	▪ Data collection is infrequent and often summative in nature. ▪ Emphasis is on general impressions and subject to numerous educational "effects" (eg, Recency, "Horns or Halo," etc). ▪ Progression is based on time spent in training rather than demonstration of competency. ▪ Frame of reference (eg, standards, criteria) for assessment is unclear.	▪ Utilize multiple assessments longitudinally across all learning venues to generate frequent and robust data. ▪ Ensure that assessments are "fit for purpose," ensuring data generation that guides the desired professional development of learners. ▪ Ensure assessments sample across Miller's Pyramid with emphasis on the "does."

[a] Adapted from Reference 6.

Programmatic Assessment in the NAS

A core principle of CBME is a program must know that the learner demonstrates the expected level of competence to advance as a trainee. To do so requires clear definitions of desired outcomes and assessment systems that accurately identify whether learners have made sufficient progress and ultimately achieve graduation outcomes. The components of programmatic assessment described in TABLE 1 are essential to this process.[5] High-quality assessment can generate data and insights to support and drive effective feedback, coaching, self-regulated learning, and professional growth.[13]

System of Programmatic Assessment

Systems thinking is necessary for effective programmatic assessment. A programmatic assessment system can be defined as a group of individuals who work together on a regular and longitudinal basis to perform, review, and improve assessments.[14] Individuals involved in this system include program directors/associate program directors, core faculty, peers, staff, and patients. Additionally, clinical competency committees (CCCs) and program evaluation committees (PECs) convene subgroups of this assessment system to provide individual learner assessment and overall training program assessment. This group must share goals of programmatic assessment, possess shared understanding of clinical and educational outcomes, create interdependent links between individual learner assessments and program evaluation, process information about learner performance (ie, both feedback and feed-forward mechanisms), and commit to producing trainees fully prepared to enter the next phase of their professional careers. Done correctly, systematic programmatic assessment utilizes both qualitative and quantitative data and professional judgement to optimize learning, facilitates decision-making regarding learner progression toward desired outcomes, and informs programmatic quality improvement activities.[14]

An idealized GME assessment system is represented in FIGURE 1. As conceptualized in this figure, programmatic assessment includes all the activities within the box and allows for robust data generation using multiple assessment methods and tools to generate data that informs the judgment of the CCC regarding learner progression. This judgement is then presented as a recommendation to the program director while also providing feedback to both faculty and learners. Building programmatic assessment requires implementing an integrated combination of assessment methods and tools for determining a learner's developmental progression in each of the 6

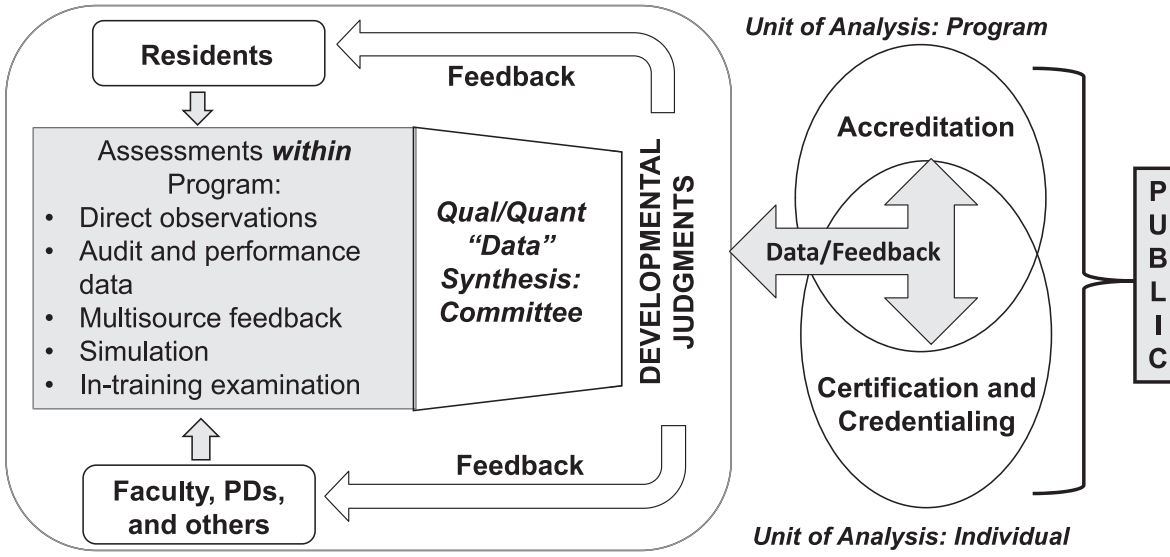

FIGURE 1
The GME Assessment System

general competencies. While not a complete list, TABLE 2 provides a core menu of assessment tools/methods appropriate for each general competency.

Programmatic assessment should also sample appropriately across all learning venues and at expected levels of learning. The Milestones provide a basic rubric for developmental progression within the competencies. Miller's Pyramid constitutes a useful framework to assist the program in choosing the right type of assessment for the developmental stage of the

TABLE 2
Examples of Recommended Core Assessment Tools/Methods By Competency to Support Programmatic Assessment

Competency	Competency-Based Assessment Options
Medical knowledge and clinical reasoning	▪ In-training examination ▪ Faculty work-based assessments ▪ Chart stimulated recall, Assessment of Reasoning Tool, others
Patient care and procedural skills	▪ Work-based clinical assessment through direct observation of the individual during care delivery ▪ Faculty and peer assessment ▪ Standardized assessments ▪ Simulation
Professionalism	▪ Informed self-assessment ▪ Multisource feedback, such as a 360-degree evaluation ▪ Patient experience surveys
Communication	▪ Patient reported feedback and experience surveys ▪ Multisource feedback, such as a 360-degree evaluation, especially regarding interprofessional care
Practice-based learning and improvement	▪ Evaluation of knowledge, skills, and attitudes from participation in systematic efforts to improve the quality, safety, or value of health care services ▪ Audit and feedback of the medical record ▪ Review of medical errors and patient safety events ▪ Evidence-based practice logs
Systems-based practice	▪ Feedback from multiple faculty evaluations regarding ability to practice in a complex health care system ▪ Multisource feedback, such as a 360-degree evaluation, especially regarding interprofessional care ▪ Assessment of cost-conscious care

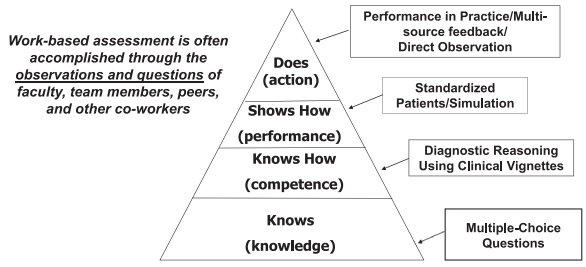

FIGURE 2
Assessing for the Desired Outcome

Competency Domain (list appropriate sub-competencies)	Rotation/Learning Experience	Method of Curriculum Delivery	Assessment Method/Tool	Frequency of Assessment	Expected Performance Level
Patient care					
Medical knowledge					
Practice-based learning and improvement					
Interpersonal and communication skills					
Professionalism					
Systems-based practice					

FIGURE 3
Programmatic Assessment Mapping Matrix

learner (FIGURE 2).[15] While the emphasis of assessment at the GME level should focus on the "does" of Miller's Pyramid, programmatic assessment should include appropriate approaches across the full continuum of "knows" to "does." Ultimately, the majority of assessment should focus on work-based assessments such as direct observation, multisource feedback, clinical performance measures, and methods to probe clinical reasoning in patient care. Finally, tracking where, how, and how frequently assessments are being completed will ensure that robust assessment is completed across all necessary competency domains throughout the program (FIGURE 3). This programmatic assessment "map" is essential in ensuring the core abilities needed by the learner are being taught and assessed.

Programmatic Assessment and the Human Element

The quality of data generated by assessment programs and individual assessment methods/tools are highly dependent on faculty's capability with them. While energy is routinely spent designing and perfecting assessment tools, most data variability generated by these instruments is due to the human element.[16] Rather than pursuing the "perfect tool," programs are better served ensuring that faculty understand the educational goals and outcomes and have a shared understanding, or mental model, of how the assessment program documents the developmental progression of learners toward those outcomes. It is no longer adequate for assessment to document only what has been learned. This same information must be shared with learners to help catalyze and define their future learning path.[17] Assessment and the feedback should address both what has been learned (assessment "of learning") and the next step in development (assessment "for learning").

Learner Role in Assessment

The learner's role in assessment has received woefully little attention in medical education. The NAS includes the requirement that residents and fellows develop individualized learning plans and leverage assessment data longitudinally to support their professional development. Learners must understand the role of assessment and utilize assessment data during their training and in preparation for unsupervised practice to support continuous professional development. A philosophy beginning to gain traction in medical education is coproduction.[18] Coproduction is based on the principle of restoring individual agency for learning and assessment to the trainee, rather than assuming it rests only with faculty. Coproduction in assessment positions the learner as an active partner generating their own self-assessments, with agency to seek assessment, feedback, and coaching, and help determine what approaches to future learning will be most helpful. These behaviors help struggling learners meet expectations, while ensuring that learners at or above the expected level of competency continue to pursue mastery. Coproduction extends and refines the CBME concept of tailored learning, or learner-centeredness.[5]

The Role of Milestones and Entrustable Professional Activities in Programmatic Assessment

The NAS Milestones provide a framework for assessing learners' developmental progression in the 6 general competencies. Description of an individual's Milestones progress provides a road map for interpreting rotation-based assessment data (especially work-based assessments) to define that individual's learning trajectories. The Milestones should guide the synthetic judgement completed biannually at the level of the CCC. Milestones were not designed to be used as standalone faculty evaluation forms.[19] If learner trajectories are consistently missing expected targets in any area of general competency growth, programs should critically review curriculum content, delivery, and assessment to ensure the educational program is providing the

BOX 1 EPAs for an Internal Medicine Cardiology Rotation[a]

- Evaluate and manage a patient admitted with chest pain.
- Manage a patient with acute atrial fibrillation and rapid ventricular response.
- Accurately interpret an ECG.
- Optimize medical therapy for acute and chronic coronary artery disease.
- Optimize medical therapy to treat systolic or diastolic heart failure.
- Manage oral and intravenous anticoagulation therapy.

[a] With permission from John McPherson, MD.

appropriate learning environment.[20] Through this process, programs can identify and remove or improve ineffective learning and assessment activities as part of programmatic quality improvement.

The Milestones can and will also need to improve. In 2016, the ACGME launched the Milestones 2.0 project to refine and revise all initial Milestones sets.[21] Milestones 2.0 addresses the substantial variability in content and developmental progression in the initial subspecialty Milestones and simplifies and standardizes language used to describe developmental progression. The ongoing Milestones 2.0 initiative has identified a set of standardized, or harmonized, subcompetencies in the 4 non–patient care and medical knowledge general competencies. Once complete, this evolution of the subspecialty Milestones will guide programs as they review and update their educational programs to ensure they continue to meet educational outcomes.

As the NAS has evolved, interest in entrustable professional activities (EPAs) has also grown. While use of EPAs is not required for ACGME accreditation, EPAs have gained support as a strategy for structuring clinical assessment. EPAs were introduced by ten Cate as a framework to define and assess essential clinical activities required of the profession.[22] EPAs describe the essential work of the *profession*, whereas Milestones and competencies frame attributes of the *learner's* abilities. While such EPAs are valuable, programs can also develop customized EPAs to document achievement of desired outcomes for specific rotations (BOX 1).

Programmatic Assessment Success

Programmatic assessment must be "fit for purpose."[14] Does an assessment program's combination of tools and methods help determine and guide learners' developmental progression and allow for feedback that informs individual learning plans and program-level improvement? If an assessment is elegantly designed and deployed but does not generate data informing these outcomes, it is insufficient. Hauer and colleagues identified 6 principles of programmatic assessment that can help avoid inadequate programmatic assessment and should be used by all programs as they implement and continuously improve programmatic assessment (BOX 2).[23]

BOX 2 Programmatic Assessment Success Principles[a]

1. Ensure a centrally coordinated plan for assessment that aligns with and supports curricular vision.
2. Utilize multiple assessment tools longitudinally to generate multiple data points.
3. Ensure learners have ready access to information-rich feedback to promote reflection and informed self-assessment.
4. Ensure that coaching programs play an essential role in the facilitation of effective data use for reflection and learning planning.
5. Develop a program of assessment that fosters self-regulated learning behaviors.
6. Ensure that expert groups (through faculty development) make summative decisions about grades and readiness for advancement.

[a] Adapted from Reference 14.

Conclusions

Programmatic assessment, using a systems-lens, is essential to assure desired outcomes in GME. The elements include high-quality multifaceted assessment methods and tools, group decision-making using best practices in group dynamics, longitudinal and developmental thinking in assessment, and a philosophy of coproduction, with learners as active partners. Without each of these, especially learners as active partners, GME risks production of learners with a limited capacity for self-directed, lifelong learning. The disruptions caused by the COVID-19 pandemic has further reinforced the importance of programmatic assessment.

References

1. Batalden P, Leach D, Swing S, Dreyfus H, Dreyfus S. General competencies and accreditation in graduate medical education. *Health Aff (Millwood)*. 2002;21(5):103–111. doi:10.1377/hlthaff.21.5.103.
2. Green ML, Aagaard EM, Caverzagie KJ, et al. Charting the road to competence: developmental milestones for internal medicine residency training. *J Grad Med Educ*. 2009;1(1):5–20. doi:10.4300/01.01.0003.
3. Nasca TJ, Philibert I, Brigham T, Flynn TC. The next GME accreditation system—rationale and benefits. *N Engl J Med*. 2012;366(11):1051–1056. doi:10.1056/NEJMsr1200117.
4. Frank JR, Snell LS, ten Cate O, et al. Competency-based medical education: theory to practice. Med Teach.

2010;32(8):638–645. doi:10.3109/0142159X.2010.501190.
5. Van Melle E, Frank JR, Holmboe ES, et al. A core components framework for evaluating implementation of competency-based medical education programs. *Acad Med*. 2019;94(7):1002–1009. doi:10.1097/ACM.0000000000002743.
6. Watson RS, Borgert AJ, O'Herion CT, et al. A multicenter prospective comparison of the Accreditation Council for Graduate Medical Education milestones: clinical competency committee vs. resident self-assessment. *J Surg Educ*. 2017;74(6):e8–e14. doi:10.1016/j.jsurg.2017.06.009.
7. Conforti LN, Yaghmour NA, Hamstra SJ, et al. The effect and use of milestones in the assessment of neurological surgery residents and residency programs. *J Surg Educ*. 2018;75(1):147–155. doi:10.1016/j.jsurg.2017.06.001.
8. Schumacher DJ, Michelson C, Poynter S, et al. Thresholds and interpretations: how clinical competency committees identify pediatric residents with performance concerns. *Med Teach*. 2018;40(1):70–79. doi:10.1080/0142159X.2017.1394576.
9. Accreditation Council for Graduate Medical Education. Guidance Statement on Competency-Based Medical Education during COVID-19 Residency and Fellowship Disruptions. https://www.acgme.org/Newsroom/Newsroom-Details/ArticleID/10639/Guidance-Statement-on-Competency-Based-Medical-Education-during-COVID-19-Residency-and-Fellowship-Disruptions. Accessed February 25, 2021.
10. American Medical Association. Murphy B. Residency in a pandemic: how COVID-19 is affecting trainees. https://www.ama-assn.org/residents-students/residency/residency-pandemic-how-covid-19-affecting-trainees. Accessed February 25, 2021.
11. American Academy of Orthopaedic Surgeons. Koso R, Siow M. The impact of COVID-19 on orthopaedic residency training. https://www.aaos.org/aaosnow/2020/jul/covid19/covid-19-res-training/. Accessed February 25, 2021.
12. Rosen G, Murray S, Greene K, Pruthi R, Richstone L, Mirza M. Effect of COVID-19 on urology residency training: a nationwide survey of program directors by the Society of Academic Urologists. *J Uro*. 2020;204(5):1039–1045. doi:10.1097/JU.0000000000001155.
13. Van Houten-Schat MA, Berkhout JJ, van Dijk N, Endedijk MD, Jaarsma ADC, Diemers AD. Self-regulated learning in clinical context: a systematic review. *Med Educ*. 2018;52(10):1008–1015. doi:10.1111/medu.13615.
14. van der Vleuten CP, Schuwirth LW, Driessen EW, et al. A model for programmatic assessment fit for purpose. *Med Teach*. 2012;34(3):205–214. doi:10.3109/0142159X.2012.652239.
15. Miller G. The assessment of clinical skills/competence/performance. *Acad Med*. 1990;65(9 Suppl):63–67. doi:10.1097/00001888-199009000-00045.
16. Williams RG, Klamen DA, McGaghie WC. Cognitive, social and environmental sources of bias in clinical performance ratings. *Teach Learn Med*. 2003;15(4):270–292. doi:10.1207/S15328015TLM1504_11.
17. Norcini, JM, Anderson B, Bollela V, et al. 2018 consensus framework for good assessment. Med Teach. 2018;40(11):1102–1109. doi:10.1080/0142159X.2018.1500016.
18. Englander R, Holmboe E, Batalden P, et al. Coproducing health professions education: a requisite to coproducing health care service? *Acad Med*. 2020;95(7):1006–1013. doi:10.1097/ACM.0000000000003137.
19. Accreditation Council for Graduate Medical Education. The Milestones Guidebook. https://www.acgme.org/Portals/0/MilestonesGuidebook.pdf?ver=2020-06-11-100958-330. Accessed February 25, 2021.
20. Holmboe ES, Yamazaki K, Nasca TJ, Hamstra SJ. Longitudinal milestones data and learning analytics to facilitate the professional development of residents: early lessons from three specialties. *Acad Med*. 2020;95(1):97–103. doi:10.1097/ACM.0000000000002899.
21. Edgar L, Roberts S, Holmboe E. Milestones 2.0: a step forward. *J Grad Med Educ*. 2018;10(3):367–369. doi:10.4300/JGME-D-18-00372.1.
22. ten Cate O. Entrustability of professional activities and competency-based training. *Med Educ*. 2005;39(12):1176–1177. doi:10.1111/j.1365-2929.2005.02341.x.
23. Hauer KE, OSullivan PS, Fitzhenry K, Boscardin C. Translating theory into practice: implementing a program of assessment. *Acad Med*. 2018;93(3):444–450. doi:10.1097/ACM.0000000000001995.

Saroj Misra, DO, FACOFP, is Associate Professor of Family & Community Medicine, Michigan State University School of Osteopathic Medicine; **William F. Iobst, MD, FACP,** is Senior Scholar, Department of Research, Milestones Development, and Evaluation, Accreditation Council for Graduate Medical Education (ACGME), and Emeritus Professor of Medicine, Geisinger Commonwealth School of Medicine; **Karen E. Hauer, MD, PhD,** is Associate Dean, Competency Assessment and Professional Standards, and Professor of Medicine, University of California, San Francisco; and **Eric S. Holmboe, MD, MACP, FRCP,** is Chief Research, Milestone Development, and Evaluation Officer, ACGME.

Corresponding author: Eric S. Holmboe, MD, MACP, FRCP, Accreditation Council for Graduate Medical Education, eholmboe@acgme.org, Twitter @boedudley