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## Original Article

## Developing a New Set of ACGME Milestones for Child Neurology Residency



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## ABSTRACT

**Background:** The Educational Milestones developed by the Accreditation Council for Graduate Medical Education (ACGME) are a construct used to evaluate the development of core competencies during residency and fellowship training. The milestones were developed to create a framework for professional development during graduate medical education. The first iteration of milestones for the child neurology residency was implemented in 2015. In the years that followed, the ACGME received and reviewed feedback about the milestones and set out to revise them.

**Methods:** A committee was assembled to review the original milestones and develop a new set of milestones. The group was also encouraged to not only consider the child neurology residency graduate of *today* but also the graduate of *tomorrow*, taking into account growing fields such as genetics and technology.

**Results:** A diverse group of 12 individuals, including 10 child neurologists (all of whom were current or previous program directors or associate program directors), one child neurology resident, and one non-physician program coordinator, were recruited from programs of varying size across the country.

**Conclusions:** The committee developed a revision to the child neurology milestones. All changes made were with a focus on how the milestones can be useful to trainees, program directors, and clinical competency committee members. Implementation and further feedback should help guide future revisions. These changes should help trainees, clinical competency committee members, and program directors find more meaning from their use.

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## Introduction

The Educational Milestones developed by the Accreditation Council for Graduate Medical Education (ACGME) are a construct used to evaluate the development of core competencies during

residency and fellowship training. The milestones are a key component of the Next Accreditation System and were first implemented in 2013.<sup>1</sup>

The milestones were developed to create a framework for professional development during graduate medical education (GME) that focuses on outcomes and is based around the six domains of clinical competency that were first introduced by the ACGME in 1999.<sup>1</sup> These include Patient Care (PC), Medical Knowledge (MK), Systems-based Practice (SBP), Practice-based Learning and Improvement (PBLI), Professionalism (PROF), and Interpersonal and Communications Skills (ICS). Each milestone is organized in a logical developmental trajectory of advancement, starting at Level 1 and increasing to Level 5. A Level 4 reflects performance that is deemed to demonstrate that one is ready for the independent practice of child neurology in that domain, with Level 4 serving as a target but not requirement for graduation and Level 5 serving as an aspirational goal that not all clinicians will achieve during training. Notably, milestones were not meant to replace or comprehensively address all program requirements for child neurology residency, but rather serve as a roadmap for growth and development. Uniform milestones used by all accredited programs ensure an educational standard across programs. Programs are required to report milestones for each of their trainees annually.

Milestones specific to child neurology residency were developed and implemented in 2015.<sup>2</sup> This first set of milestones included 15 PC milestones, four MK milestones, two SBP milestones, two PBLI milestones, two PROF milestones, and two ICS milestones.

In the years that followed, the ACGME sought and received feedback regarding the milestones. Several limitations came to light including themes of too many subcompetencies, which were cumbersome and filled with “eduspeak.” In response to the lessons learned following implementation, the ACGME started working to revise the milestones for all specialties, including child neurology.<sup>3</sup> The aim of the second iteration of the milestones is to make them more user-friendly for program directors and clinical competency committee (CCC) members and more meaningful to trainees. When possible, the second iteration also sought to develop harmonized milestones, specifically for the ICS, PBLI, PROF, and SBP milestones that contain themes that are shared across all medical specialties.<sup>4</sup>

## Methods

### Participants

The ACGME recruited child neurologists and those involved in child neurology training. Representatives of the ACGME Neurology Review Committee, American Board of Psychiatry and Neurology, and the Consortium of Neurology Program Directors at the American Academy of Neurology were appointed. The remaining members were selected from a group of volunteers demonstrating an interest and dedication to medical education, including one child neurology resident. Volunteers were selected based on several criteria for the structure of the overall group, including diversity of experience (residents, early faculty, mid-faculty, and senior faculty), program size, geographic diversity, and a demonstrated ongoing interest in the milestones. The interest was demonstrated through graduate work in medical education and the responses to two questions in the application. Finally, a non-physician member was also selected.

A brief pre-meeting survey with quantitative and qualitative questions was sent to child neurology program directors to elicit feedback specific to the original child neurology milestones that could be addressed in the 2.0 revision. Specific questions asked about each individual milestone included whether the milestone

appropriately set a realistic progression of knowledge, skills, and behaviors; whether the milestone discriminated between meaningful competence; whether the milestone should be edited or deleted; whether additional content should be added; and whether respondents felt they were able to evaluate residents' skills with the milestone set.

### Milestone development

An introduction to the milestones was provided by the ACGME Milestones leadership (L.E.) as a foundation. The process began with development of a shared mental model of what knowledge and skills a competent child neurology residency graduate who is ready for independent practice *should* possess. The group was also encouraged to not only consider the child neurology residency graduate of *today* but also the graduate of *tomorrow*, taking into account growing fields such as genetics and technology. Finally, the group needed to consider the impact of graduating competent child neurologists on future patients as well as the society at-large, an important focus of the ACGME as an accrediting body. After reaching a consensus opinion on the most important areas of medical knowledge and skills, the committee developed subcompetencies and related themes for each subcompetency. To illustrate the practical application of each subcompetency and related themes, a Supplemental Guide was created with examples illustrating achievement of the different skill levels based upon typical patients encountered by a child neurology resident. Working in large and small groups, the work was completed and reviewed, and then made available for public comment. After a period of public comment, final edits were made and the “Milestones and Supplemental Guide” were published on the ACGME website.<sup>5</sup> Residency programs will be required to report the new milestones starting in the 2021-2022 academic year.

## Results

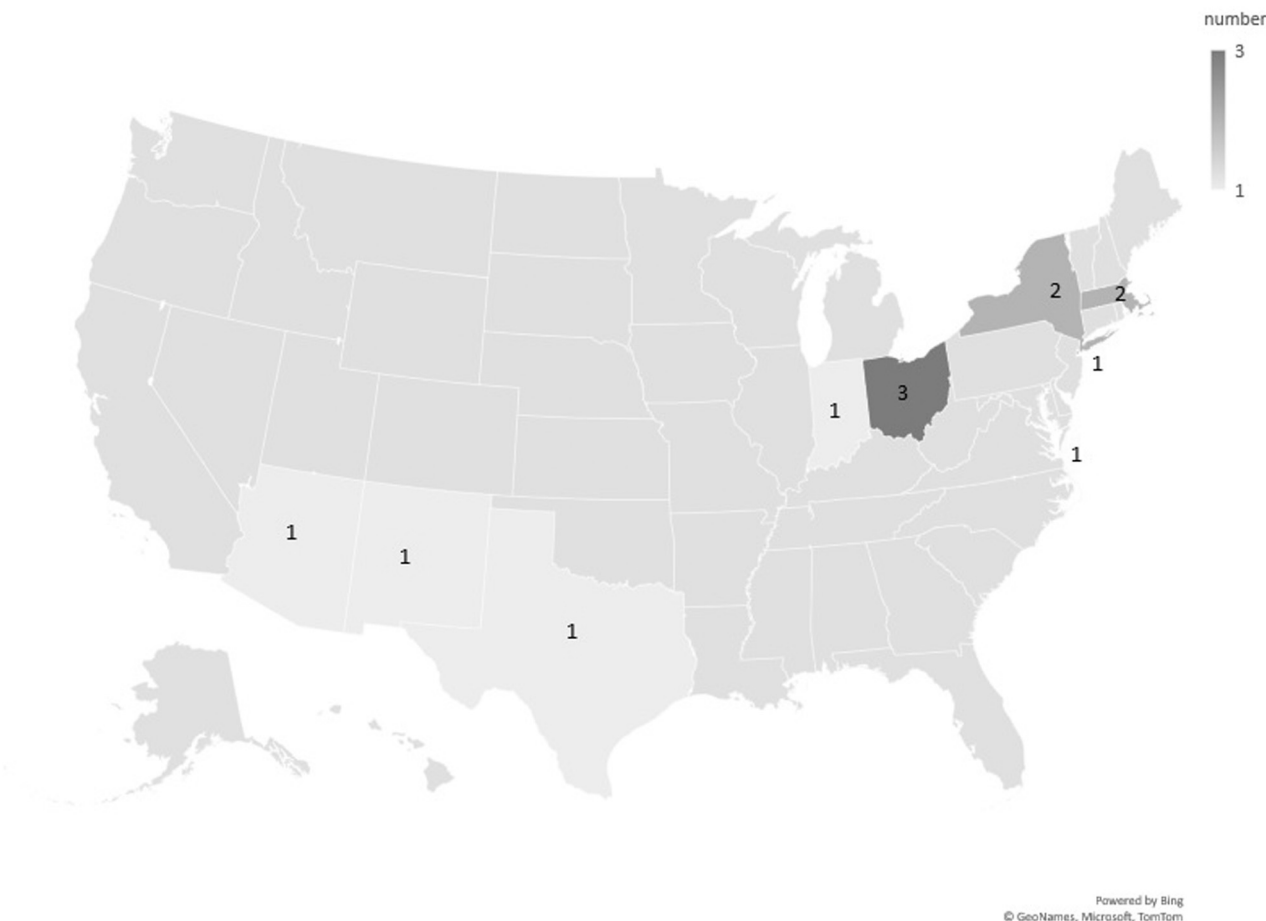
### Participants

A diverse group of 12 individuals, including 10 attending child neurologists (all of whom were current or previous program directors or associate program directors), one child neurology resident, and one non-physician program coordinator, were recruited from different programs of varying size across the country (Fig 1). Committee members also represented residency programs of varying size. The committee met at the Headquarters of the ACGME in Chicago, IL, three times for a total of 33 hours of meeting time. By comparison, the Child Neurology Milestones 1.0 committee was composed of 10 child neurologists who were all appointed by the Review Committee, American Board of Psychiatry and Neurology, and Consortium of Neurology Program Directors, and no non-physician person.

Once the milestones and Supplemental Guide were completed, they were made available for public comment for three weeks. During that time, we received feedback from nine individuals and the comments were reviewed by the committee to determine if changes were needed.

### Pre-meeting survey results

The survey was sent to 76 programs. In total, 23 individuals responded to the survey, although not all respondents replied to every question or provided comments. Qualitative and quantitative responses were reviewed regarding their impressions of the initial child neurology milestones. Some of the qualitative feedback included a desire to reduce the number of milestones, whereas



**FIGURE 1.** States from which participants originated. One member originated from the District of Columbia, which is not visible in this image. (Map was created using Excel.)

others wanted to add additional milestones or add specific content (such as genetic evaluations) that were deemed “missing”; others commented that the milestones were “vague, difficult to assess.” There were also comments regarding the use of “engages in scholarly activity” as the aspirational goal of a Level 5 resident. Overall, there were no consistent themes in the responses. The comments we found to be most crucial, as interpreted by the committee, were largely addressed by the revision of the milestones.

*Patient care and medical knowledge milestones*

Ten PC milestones and four MK milestones were developed for the 2.0 revision (Table 1). These milestones pertain to critical skills to be achieved by the child neurology resident, including taking an appropriate neurological and developmental history, performing a neurological examination, interpreting important neurodiagnostic studies such as electroencephalogram and electromyography, and performing a lumbar puncture and determination of death by neurological criteria. The intent of each milestone is listed in Table 2 as well as in the Supplemental Guide.

*Harmonized milestones*

As part of the 2.0 revision, the ACGME developed 11 “Harmonized Milestones,” with four interdisciplinary, interprofessional groups that address shared competencies across all specialties of medicine in SBP, PBLI, PROF, and ICS. The child neurology

milestones committee reviewed these harmonized milestones and adapted as appropriate to our specialty. The intent of each milestone is listed in Table 2 as well as in the Supplemental Guide.

*Supplemental Guide*

As a companion to the milestones 2.0 revision, the group developed a Supplemental Guide that is meant to help CCC members ascertain how to apply the standards. It contains concrete and specific examples of how the committee interprets each milestone and lists suggested resources to be used for further guidance.

**Discussion**

*Comparison to milestones 1.0*

There are several appreciable differences between milestones 1.0 and the 2.0 revision, with the goal of making improvements based on prior feedback to be more user-friendly for program directors and CCC members as well as more meaningful to trainees (Table 1). Included in the changes are new options to help programs differentiate between learners who have critical deficiencies (not yet completed; Level 1) and those who have not yet rotated or had adequate assessments (not yet assessable) for a subcompetency.

Another difference is that the patient care subcompetencies have been shifted from a disease-state or subspecialty focus (for example, epilepsy, neuromuscular) to a care-setting focus (for

**TABLE 1.**  
Comparing and Matching the Milestones in the First Iteration and the Milestones in the 2.0 Revision

Milestones 1.0	Milestones 2.0
PC1: History	PC1: Neurologic and Developmental History
PC2: Neurologic Exam	PC2: Neurologic Exam
PC3: Management/Treatment	PC10: Determination of Death by Neurologic Criteria PC3: Critical Care
PC4: Neurometabolic and Neurogenetic Disorders	PC4: Diagnosis and Management in the Inpatient Setting PC5: Diagnosis and Management in the Outpatient Setting PC3: Critical Care
PC5: Movement Disorders	PC4: Diagnosis and Management in the Inpatient Setting PC5: Diagnosis and Management in the Outpatient Setting PC3: Critical Care
PC6: Neuromuscular Disorders	PC4: Diagnosis and Management in the Inpatient Setting PC5: Diagnosis and Management in the Outpatient Setting PC3: Critical Care
PC7: Cerebrovascular Disorders	PC4: Diagnosis and Management in the Inpatient Setting PC5: Diagnosis and Management in the Outpatient Setting PC9: Electromyography PC3: Critical Care
PC8: Cognitive, Behavioral, and Psychiatric Disorders	PC4: Diagnosis and Management in the Inpatient Setting PC5: Diagnosis and Management in the Outpatient Setting PC3: Critical Care
PC9: Neuroimmunologic and White Matter Disorders	PC4: Diagnosis and Management in the Inpatient Setting PC5: Diagnosis and Management in the Outpatient Setting PC3: Critical Care
PC10: Epilepsy	PC4: Diagnosis and Management in the Inpatient Setting PC5: Diagnosis and Management in the Outpatient Setting PC3: Critical Care
PC11: Headache Syndromes	PC4: Diagnosis and Management in the Inpatient Setting PC5: Diagnosis and Management in the Outpatient Setting PC3: Critical Care
PC12: Neuro-Oncology	PC4: Diagnosis and Management in the Inpatient Setting PC5: Diagnosis and Management in the Outpatient Setting PC3: Critical Care
PC12: Neuroimaging	PC4: Diagnosis and Management in the Inpatient Setting PC5: Diagnosis and Management in the Outpatient Setting PC6: Neuroimaging
PC13: Electroencephalogram	PC7: Electroencephalogram
PC14: Lumbar Puncture	PC8: Lumbar Puncture
MK1: Development	MK1: Development and Behavior
MK2: Localization	MK2: Localization
MK3: Formulation	MK3: Clinical Reasoning and Formulation
MK4: Diagnostic Investigation	MK4: Diagnostic Investigation
SBP1: Systems thinking, including cost- and risk-effective practice	SBP1: Patient Safety and Quality Improvement
SBP2: Work in inter-professional teams to enhance patient safety	SBP3: Physician Role in Health Care Systems SBP1: Patient Safety and Quality Improvement
PBL1: Self-directed Learning	ICS2: Interprofessional and Team Communication PBLI2: Reflective Practice and Commitment to Personal Growth
PBLI2: Locate, appraise, and assimilate evidence from scientific studies related to the patient's health problems	PBLI1: Evidence-Based and Informed Practice
PROF1: Compassion, integrity, accountability, and respect for self and others	PROF1: Professional Behavior and Ethical Principles
PROF2: Knowledge about, respect for, and adherence to the ethical principles relevant to the practice of medicine	PROF2: Accountability/Conscientiousness PROF1: Professional Behavior and Ethical Principles
No match	PROF3: Self-Awareness and Well-Being
ICS1: Relationship development, teamwork, and managing conflict	ICS1: Patient and Family-Centered Communication ICS3: Interprofessional and Team Communication
ICS2: Information sharing, gathering, and technology	SBP2: System Navigation for Patient-Centered Care ICS2: Patient and Family Education ICS4: Communication within Health Care Systems

Abbreviations:

- ICS = Interpersonal and communication skills
- MK = Medical knowledge
- PBLI = Practice-based learning and improvement
- PC = Patient care
- PROF = Professionalism
- SBP = Systems-based practice

example, inpatient care, outpatient care). This was done in an effort to limit the total number of milestones (15 PC milestones decreased to 10 PC milestones with the 2.0 revision), and also because clinical competency development in a care setting is more broadly applicable across training as opposed to within a specific subspecialty.

For example, an individual resident may only spend a one-month rotation in a given subspecialty area, so there is less opportunity to show a developmental trajectory throughout training within that discipline; however, residents will spend a large amount of training in a given care area such as the outpatient clinic.

**TABLE 2.**  
The Overall Intent of Each Milestone

Milestones 2.0	Overall Intent of Each Milestones
PC1: Neurologic and Developmental History	To efficiently obtain, communicate, and document a history that addresses the neurologic question
PC2: Neurologic Exam	To efficiently obtain, communicate, and document a developmentally appropriate physical examination that addresses the neurologic question
PC3: Critical Care	To diagnose and manage critical illnesses and emergencies that affect the nervous system
PC4: Diagnosis and Management in the Inpatient Setting	To gain competence in diagnosing and managing patients with neurological symptoms and disorders in the inpatient setting
PC5: Diagnosis and Management in the Outpatient Setting	To diagnose and manage patients with neurological symptoms and disorders in the outpatient setting
PC6: Neuroimaging	To use and interpret developmental and acquired abnormalities on neuroimaging
PC7: Electroencephalogram	To interpret and create reports for common EEG abnormalities
PC8: Lumbar Puncture	To independently perform lumbar puncture in the appropriate settings
PC9: Electromyography	To interpret results of nerve conduction study/electromyogram testing
PC10: Determination of Death by Neurologic Criteria	To make an appropriate determination of death using neurologic criteria
MK1: Development and Behavior	To demonstrate sufficient knowledge to counsel families regarding common disorders of motor, emotional, cognitive, and behavioral development
MK2: Localization	To localize neurologic deficits to specific locations in the nervous system and apply their hypothesis to patient management
MK3: Clinical Reasoning and Formulation	To reach an accurate differential diagnosis based on age and clinical symptomatology; to modify the differential diagnosis if the clinical symptoms evolve
MK4: Diagnostic Investigation	To implement a targeted, cost-effective plan for high-yield diagnostic testing in patients with neurologic complaints
SBP1: Patient Safety and Quality Improvement	Engages in the analysis and management of patient safety events, including relevant communication with patients, families, and health care professionals; is able to conduct a QI project
SBP2: System Navigation for Patient-Centered Care	To effectively navigate the health care system, including the interdisciplinary team and other care providers; to adapt care to a specific patient population to ensure high-quality patient outcomes
SBP3: Physician Role in Health Care Systems	To understand one's own role in the treatment team and in the complex health care system and how to optimize the system to improve patient care and the health system's performance
PBL1: Evidence-Based and Informed Practice	To incorporate evidence into clinical practice
PBL2: Reflective Practice and Commitment to Personal Growth	To seek clinical performance information with the intent to improve care; to reflect on all domains of practice, personal interactions, and behaviors, and their impact on colleagues and patients (reflective mindfulness); to develop clear objectives and goals for improvement in some form of a learning plan
PROF1: Professional Behavior and Ethical Principles	To recognize and address lapses in ethical and professional behavior, demonstrate ethical and professional behaviors, and use appropriate resources for managing ethical and professional dilemmas
PROF2: Accountability/Conscientiousness	To take responsibility for one's own actions and the impact on patients and other members of the health care team
PROF3: Self-Awareness and Well-Being	To identify, use, manage, improve, and seek help for personal and professional well-being for self and others
ICS1: Patient and Family-Centered Communication	To deliberately use language and behaviors to form constructive relationships with patients, to identify communication barriers including self-reflection on personal biases, and minimize them in the doctor-patient relationships; organize and lead communication around shared decision-making
ICS2: Interprofessional and Team Communication	To effectively educate patients and use shared decision making to improve outcomes
ICS3: Interprofessional and Team Communication	To effectively communicate with the health care team, including consultants, in both straightforward and complex situations
ICS4: Communication within Health Care Systems	To communicate effectively using a variety of methods

**Abbreviations:**

EEG = Electroencephalography

ICS = Interpersonal and communication skills

MK = Medical knowledge

PBL = Practice-based learning and improvement

PC = Patient care

PROF = Professionalism

SBP = Systems-based practice

This is also listed in the Supplemental Guide.

Additionally, for most patient care milestones, scholarly activity was removed as a requirement to achieve a Level 5 and in many instances attributed "serves as a role model" as the aspirational goal of a Level 5 trainee.

In milestones 2.0, the harmonized milestones were a new concept created to address the common and overlapping themes and to reduce variation between subspecialties for ICS, PBL, PROF, and SBP. This creates an opportunity to share assessment tools and provide comprehensive development across subspecialties given these milestones apply in all fields of medicine. When appropriate, the harmonized milestones were edited to be more applicable to the child neurology resident.

Last, perhaps one of the most important contributions to the 2.0 revision was the development of a Supplemental Guide with examples to help program directors and CCC members apply the milestones, as well as for residents to have concrete examples of how their learning may develop as training progresses. Programs

can apply the examples as written or can develop their own examples for application within the residency. This guide is meant to help programs apply the milestones with greater accuracy and precision and reduce some of the "vagueness" that was a concern of the initial version of the milestones. The Supplemental Guide also provides some suggestions for assessment models or tools and resources for each milestone (a sample milestone from the Supplemental Guide is shown in Fig 2).

*Suggestions for assessment of the milestones within residency programs*

Milestones are intended to be used as a framework for program directors to demonstrate steps to developing competence of trainees within a GME program. Tracking progress along a developmental trajectory allows residents to see what skills they have successfully acquired and what skills they still need to acquire

Practice-Based Learning and Improvement 1: Evidence-Based and Informed Practice	
Overall Intent: To incorporate evidence into clinical practice	
Milestones	Examples
Level 1 Uses available evidence to care for a routine patient	<ul style="list-style-type: none"> <li>Searches for review article on Duchenne muscular dystrophy</li> </ul>
Level 2 Articulates clinical questions to guide evidence-based care	<ul style="list-style-type: none"> <li>Search for evidence for use of steroids in Duchenne muscular dystrophy</li> </ul>
Level 3 Locates and applies the best available evidence to the care of complex patients	<ul style="list-style-type: none"> <li>Uses clinical practice guideline from American Academy of Neurology (AAN) to treat patients with Duchenne muscular dystrophy</li> </ul>
Level 4 Critically appraises and applies evidence even in the face of uncertainty and conflicting evidence to guide care	<ul style="list-style-type: none"> <li>Reviews and analyzes a primary research article on the treatment of Duchenne muscular dystrophy that contradicts current practice</li> <li>Reviews multiple articles on treatment of infantile spasms to determine appropriate treatment</li> </ul>
Level 5 Coaches others to critically appraise and apply evidence for complex patients; and/or participates in the development of guidelines	<ul style="list-style-type: none"> <li>Coaches or is sought out by others in analyzing research</li> <li>Reviews literature in order to update departmental protocols</li> </ul>
Assessment Models or Tools	<ul style="list-style-type: none"> <li>Direct observation</li> <li>Journal club</li> <li>Oral or written examination</li> <li>Portfolio review</li> <li>Presentation</li> </ul>
Curriculum Mapping	<ul style="list-style-type: none"> <li></li> </ul>
Notes or Resources	<ul style="list-style-type: none"> <li>National Institutes of Health. Write Your Application. <a href="https://grants.nih.gov/grants/how-to-apply-application-guide/format-and-write/write-your-application.htm">https://grants.nih.gov/grants/how-to-apply-application-guide/format-and-write/write-your-application.htm</a>. 2019.</li> <li>U.S. National Library of Medicine. PubMed Tutorial. <a href="https://www.nlm.nih.gov/bsd/disted/pubmedtutorial/cover.html">https://www.nlm.nih.gov/bsd/disted/pubmedtutorial/cover.html</a>. 2019.</li> <li>Institutional IRB guidelines</li> <li>Various journal submission guidelines</li> </ul>

FIGURE 2. An example table from the Supplement Guide for a Milestone (PBL1).

before independent practice. The milestones are meant to guide formative feedback and are not meant to be summative. For that reason, there is not a “pass/fail” line or minimum level for graduation from residency, and Level 4 is designated as a graduation goal, not requirement.

Specific examples of assessment modalities for child neurology residency are limited in the literature. We suggest programs consider developing clinical evaluations for program faculty to complete develop assessments that relate to the milestones. One type of evaluation that is gaining favor in medical schools and GME programs is the Entrustable Professional Activities (EPAs) that can be linked to the milestones. An EPA evaluation asks a supervising physician the degree to which they trust the trainee to perform an essential professional activity without supervision.<sup>6</sup> For example, an evaluation of an EPA for a child neurology resident might be “Do you trust this resident to perform a full and precise neurological exam pertinent to the patient’s presenting symptom?” This would map to PC2 at a Level 4, which states “Efficiently performs, communicates and documents a precise neurological exam pertinent to the patient’s presenting problem.”

Other methods of evaluation could be employed within residency programs to assess resident progress on the milestones, such as direct clinical observations, medical record reviews (audits), simulation, or Objective Standardized Clinical Examinations (OSCEs). OSCEs are used to simulate clinical environments in a standardized way to assess and provide feedback on various clinical and procedural skills. Recently, Albert et al. demonstrated the use of a communication-based OSCE for assessing child neurology resident communication skills.<sup>7</sup>

Last, we suggest that each program review the Supplemental Guide and edit it to meet its program expectations. Doing this will help the CCC create a shared mental model of the expectations for each level.

**Limitations**

We recognize that the development of a competent child neurologist who is ready to enter practice is incredibly

multifaceted. It is difficult to distill 36 months of training and all that it entails into discrete definable elements, even with the 26 milestones we have developed here, and as such there are some inherent limitations. First, although we see this largely as an improvement to the milestones 1.0 revision, removing the disease-specific focus does hamper the ability of showing development with specificity in many fields. Programs will need to consider how to continue to expose their residents to a broad variety of clinical experiences across child neurology and support professional growth in these areas.

**Conclusions**

We developed a revision to the child neurology milestones based on feedback and practical experience with many differences and improvements from the original. All changes made were with a focus on how the milestones can be useful to trainees, program directors, and clinical competency committee members. Implementation and further feedback should help guide future revisions.

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