# Introducing the Neurology Milestones 2.0

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The turn of the 21st century heralded a new era in medical education. The Institute of Medicine reports *To Err is Human* and *Crossing the Quality Chasm* called for reform of the health care system to improve the quality and safety of patient care.[1,2] Concurrently, interest in competency-based medical education increased, and the alignment of an outcomes-based approach to education with the Institute for Healthcare Improvement's "Triple Aim" of health care set the stage for the ongoing transformation in medical education.[3,4] A major component of this transformation, specific to graduate medical education (GME), has been the Next Accreditation System (NAS) of The Accreditation Council for Graduate Medical Education (ACGME).

The ACGME began work on the NAS in the late 2000s, intending to help residency and fellowship programs focus on outcomes of their learners rather than process in their educational programs and strive for continuous quality improvement.[5] The Milestones Project was born as a key element of measuring and reporting educational outcomes in the NAS. The initial iteration of Neurology Milestones, introduced in 2014, was a significant achievement in our field towards implementing outcomes-based assessments of neurology residents. Subsequent experience with the Milestone set, however, has exposed various weaknesses, impracticalities, and inconsistencies with the expected developmental trajectory of residents as they progress towards the independent practice of neurology. Neurology Milestones 2.0 aim to improve upon the first iteration of Milestones and provide a better framework for residency programs and learners to engage in outcomes-based assessment of learning. Herein, we describe the process, rationale, and products of the Neurology Milestones 2.0 Work Group, which were implemented across US neurology residency programs in July 2021.

## The First Neurology Milestones: Development & Reactions

The Neurology Milestones Work Group first met in 2011. Representatives from the ACGME Review Committee for Neurology, educators appointed by the American Board of Psychiatry and Neurology, and the Consortium of Neurology Program Directors (CNPD) of the American Academy of Neurology comprised the committee. Members were intentionally selected to represent various neurology subspecialties and residency programs of diverse size, geography, and resources. An additional Milestones Advisory Group was assembled to help communicate the Milestones to the program director community and to provide feedback to the Work Group during the process. A resident and a fellow member served on the Work and Advisory Groups, respectively.

The Neurology Milestones Work Group embarked on its process of Milestone development 4 years after internal medicine introduced its first version of the Milestones in 2007. This work began in earnest at ACGME in 2010. Lessons learned in the first years of this work informed the process and generated a standard template with patient care and medical knowledge Milestones listed first, followed by Milestones addressing the general competencies of systems-based practice, practice-based learning and improvement, professionalism, and interpersonal and communication skills. The Neurology Work Group reviewed examples of other specialties' Milestones and ultimately defined domains specific to neurology training: the patient care subcompetencies of the neurologic history, the neurologic

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Neurology Milestones 2.0 Work Group coinvestigators are listed in the appendix at the end of the article.



 

## Glossary

**ACGME** = Accreditation Council for Graduate Medical Education; **CCC** = clinical competency committee; **CNPD** = Consortium of Neurology Program Directors; **GME** = graduate medical education; **MK** = medical knowledge; **NAS** = Next Accreditation System; **PC** = patient care.

examination, management/treatment, 11 neurologic subspecialties, as well as procedural subcompetencies to include neuroimaging interpretation, EEG, nerve conduction studies/EMG, and lumbar puncture. Medical knowledge subcompetencies in localization, formulation, and diagnostic investigation rounded out this original conception of Milestones specific to neurology training.

During additional meetings, the Work Group revised language in the subcompetencies and wrote the Milestones for the general competencies. After feedback from the CNPD and the Milestone Advisory Group, along with input from programs that piloted use of the Milestones in 2012, the inaugural version of Neurology Milestones was completed in late 2012.[6] The completed Milestone set was then posted for public comment per the usual ACGME process, with the Work Group reviewing and responding to those comments. The final version with 29 subcompetencies was then forwarded for approval through ACGME and launched in 2014, with nearly all neurology programs reporting Milestones data by 2015.

In 2018, the ACGME published reflections on the experience of the first years of Milestone reporting. Milestone use and reporting had been very robust, with >99% of all ACGME-accredited programs reporting Milestone assessments on >100,000 residents in the first academic year after implementation. A small number of early studies revealed mixed results regarding the effect of Milestones implementation on the quality of formative feedback provided to residents, with faculty competency in Milestone use being an important effect modifier.[7] Stakeholders also expressed concern about inconsistencies between the general competency Milestones in each specialty, which limited cross-specialty collaboration to develop assessment tools and faculty development resources.[8] Others have cited insufficient practical guidance on Milestone assessment as a limitation of the original Milestones. As an example, a recent study of graduating neurology residents across 3 programs demonstrated no correlation between the graduates' performance during a simulated status epilepticus case and the level of Milestone achievement on the Epilepsy subcompetency, as informed by end of rotation evaluations.[9] This example highlights the need for further study of the Milestones specific to neurology education.

## Neurology Milestones 2.0: The Next Iteration

The ACGME Milestones project was designed as an iterative process, with the first major update planned to begin 3 to 5 years after the release of the initial Milestones. Through meetings with stakeholders and qualitative assessment, the development team determined that simplification of Milestones and standardization across specialties would afford greater opportunities for collaboration and sharing of assessment tools. The Milestones 2.0 Work Group (Table 1) convened in 2018 with the primary goals of (1) reducing Milestone complexity and variability, (2) enhancing stakeholder engagement in the Milestones development process, and (3) augmenting supplemental tools and resources for medical educators to aid in implementation.[8]

A major step toward standardization in Milestones 2.0 was the introduction of "harmonized" Milestones in 4 of the 6 core competency domains. This resulted from the analysis performed by 4 work groups, each tasked with examining one domain: interpersonal and communication skills, practice-based learning and improvement, professionalism, or systems-based practice. The competencies in these domains are grounded in research that shows higher levels of competence are associated with better outcomes for patients and include patient safety and quality improvement.[3,10,11] Each work group examined its assigned competency within the initial Milestones sets from the transitional year and 26 specialties. The results of this review formed the basis of standardized, or harmonized, Milestones in that competency to be applied universally. This represented a marked shift allowing for the easier creation of ACGME resources and collaboration in assessment efforts across all specialties.[8,12,13]

The task of addressing the remaining 2 domains—medical knowledge (MK) and patient care (PC)—has been undertaken by each specialty's specific Milestones 2.0 Work Group. In neurology, the Work Group was selected to include a broad range of stakeholders, including members of the initial Milestone development group, members of the review committee, allopathic and osteopathic program directors, volunteers from the neurology education community, and public members. Neurology Milestones 2.0 did not include an advisory group. The 2.0 Work Group was tasked with incorporating feedback gathered at the 2nd ACGME Milestones Summit in 2016, as well as through interviews and focus groups of stakeholders across GME, that called for a reduction in the length of individual Milestones and complexity of language.[12] In response, the language of MK and PC subcompetencies was simplified and the listed behaviors within each subcompetency level were reduced to a maximum of 2. Within each Milestone, the Work Group also attempted to revise or eliminate subcompetencies that do

**Table 1** Milestones 2.0 Work Group

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|---|
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not allow for a trajectory of development (e.g., binary assessments such as "visualize papilledema"). Minor changes to harmonized Milestones were also made as appropriate for neurology training.

Perhaps the most significant changes in the PC section were the elimination of subcompetencies that were overly specific to a subspecialty/disease or those that only applied to a limited set of patient encounters during training. Instead, context-based subcompetencies that could be applied in the most commonly encountered patient care locations and learning environments were added. For example, Figure 1 compares the cerebrovascular disorders PC subcompetency from the original Milestones with the inpatient care PC subcompetency of Milestones 2.0, which could be applied readily to care of patients with cerebrovascular disorders in the inpatient setting. By choosing to focus on core patient care skills universal to all subspecialties, the Work Group was able to streamline the Milestones 2.0 PC subcompetencies. A comparison of PC and MK subcompetencies from the original Milestones and Milestones 2.0 is presented in Table 2.

In addition to reducing Milestone complexity, the Milestones 2.0 Work Group was charged to develop a Supplemental Guide to aid the implementation of the new Milestones at the program level. The Supplemental Guide is described in further detail below. The proposed supplemental guide and the draft Neurology Milestones 2.0 were released for public comment in February 2020. The COVID-19 pandemic delayed the Work Group's response to comments, and ultimately the ACGME postponed implementation of Neurology Milestones 2.0 to July 2021. All residents should now be assessed based on Milestones 2.0, regardless of stage in training. To aid in this transition, the ACGME has published *A Guidebook for Implementing and Changing Assessment in the Milestones Era* with details and practical suggestions regarding the implementation of Milestones 2.0.[14]

## Recommended Use of Neurology Milestones 2.0

The ACGME Neurology Milestones 2.0 set is intended for multiple purposes, including creating a shared mental model between faculty and learners about performance expectations at different points along a growth trajectory, providing an assessment framework for each residency program's clinical competency committee (CCC), and establishing a standard structure in which all accredited neurology residency programs report individual performance outcomes to the ACGME. An example subcompetency is presented in Figure 1B. The full Milestones document can be accessed on the ACGME website.[19]

Use of the Milestones facilitates transparency in the review process, as all faculty and residents have access to the publicly available Milestones 2.0 document and Supplemental Guide. All parties thus develop a common understanding of the observed behaviors that delineate a certain level of proficiency and have a roadmap of expectations for further growth. In fact, residents can use Milestones 2.0 to inform their individualized learning plans to drive and assess their own professional development.

A residency program's CCC consists primarily of clinical faculty but may include other members as well. CCCs commonly use evaluation forms with ACGME Milestones terminology as part of the performance review process.[15] The CCC reviews resident performance in all 6 competency domains at least every 6 months, or more often if there are concerns that merit more frequent assessment and follow-up. The program director then shares the CCC's review feedback with each resident. The mid-year and year-end CCC Milestones ratings for each resident are submitted to the ACGME, which aggregates the data to track resident skills and competency development as part of residency program accreditation.

Milestones 2.0 are not intended to be a "go/no-go" determination of a resident's readiness for advancement or graduation. Determination of readiness for unsupervised practice is a complex process that includes satisfactory completion of program requirements, input from the CCC, longitudinal developmental progression outlined in Milestones 2.0, and feedback from the broader faculty, as well as other sources for assessment. The program director then assimilates these multisource data to confirm the resident has met all ACGME and program requirements and has attained a sufficient level of competency for independent practice. At that point, the program director has a final summative assessment

**Figure 1** Example of a Subspecialty Focused Patient Care Subcompetency From the Original Neurology Milestones Compared With the Patient Care Subcompetency Focused on the Inpatient Care Setting

A

| Cerebrovascular Disorders — Patient Care | | | | |
|---|---|---|---|---|
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| • Recognizes when a patient may have a cerebrovascular disorder | • Describes stroke syndromes and etiologic subtypes<br>• Identifies cerebrovascular emergencies<br>• Lists indications and contraindications for intravenous thrombolytic therapy | • Identifies specific mechanism of patient's cerebrovascular disorder<br>• Appropriately refers for interventional or surgical evaluation<br>• Manages common cerebrovascular disorders including appropriate use of thrombolytics | • Diagnoses uncommon cerebrovascular disorders | • Manages uncommon cerebrovascular disorders<br>• Engages in scholarly activity in cerebrovascular disorders (e.g., teaching, research) |
| ☐ | ☐ | ☐ | ☐ | ☐ ☐ ☐ ☐ |
| Comments: | | | | Not yet rotated ☐ |

B

| Patient Care 5: Diagnosis and Management of Neurologic Disorders in the Inpatient Setting | | | | |
|---|---|---|---|---|
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Identifies typical presentations of commonly encountered neurologic conditions | Diagnoses commonly encountered neurologic conditions<br><br>Develops an initial treatment plan for commonly encountered neurologic disorders | Identifies atypical presentations of commonly encountered neurologic conditions<br><br>Individualizes management plan, ensuring the appropriate level of care throughout hospitalization and upon discharge | Diagnoses uncommon neurologic conditions<br><br>Adapts management plan based upon treatment response, disease progression, and complications of therapy | Identifies atypical presentations of uncommon neurologic conditions<br><br>Leads the management of patients with complex and uncommon neurologic conditions |
| ☐ | ☐ | ☐ | ☐ | ☐ ☐ ☐ ☐ ☐ |
| Comments: | | | | Not Yet Completed Level 1 ☐<br>Not Yet Assessable ☐ |

(A) Patient care subcompetency from the original Neurology Milestones. (B) Patient care subcompetency focused on the inpatient care setting. Reproduced with permission from the Accreditation Council for Graduate Medical Education.[19]

meeting with each resident to review these data and confirm readiness for graduation.

## Introducing the Supplemental Guide

The Supplemental Guide has been newly developed as a companion to the Milestones 2.0 document. As noted, Milestones 2.0 are intended to augment rather than replace individualized assessment methods already in place in a program or institution. The Supplemental Guide was created to help programs align Milestones 2.0 with existing methods of assessment, such that significant changes to a program's overall resident assessment system will not be necessary. As stated in the ACGME Milestones Guidebook, "The Supplemental Guide is intended to help programs understand the subcompetency, and can help the CCC form its own shared mental model for local implementation."[16] For each subcompetency, the supplemental guide describes the intent of the Milestones 2.0 Work Group in determining the trajectory and provides examples of a resident performing at each level. Suggested models and tools, as well as background resources, are also provided. The supplement for the subcompetency in Figure 1B is shown in Figure 2. The full Milestones Supplemental Guide document can be accessed on the ACGME website.[20]

The Milestones 2.0 Work Group developed the Supplemental Guide after the group had completed and internally revised the Milestones. Consistent with the intent of the supplemental guide, this process aided the Work Group in clarifying a mental model for each Milestone level, and in some instances led to minor revisions to Milestones. The Supplemental Guide was

**Table 2** Comparison of Patient Care and Medical Knowledge Subcompetencies From the Original Milestones and Milestones 2.0

| Original Milestones | Milestones 2.0 |
|---|---|
| **History and examination (Patient Care)** | |
| History | History |
| Neurologic examination | Neurologic examination |
| | Formulation[b] |
| **Disease/context-specific diagnosis and management (Patient Care)** | |
| Management/treatment[a] | Diagnosis and management of neurologic disorders in the outpatient setting[c] |
| Movement disorders[a] | Diagnosis and management of neurologic disorders in the inpatient setting[c] |
| Neuromuscular disorders[a] | Diagnosis and management of neurologic emergencies[c] |
| Cerebrovascular disorders[a] | Determination of death by neurologic criteria[c] |
| Cognitive/behavioral disorders[a] | Psychiatric and functional aspects of neurology |
| Demyelinating disorders[a] | |
| Epilepsy[a] | |
| Headache syndromes[a] | |
| Psychiatry for the adult neurologist | |
| Neurologic manifestations of systemic disease[a] | |
| Child neurology for the adult neurologist[a] | |
| Neuro-oncology[a] | |
| **Supplemental testing (Patient Care)** | |
| Neuroimaging | Interpretation of neuroimaging |
| EEG | EEG |
| Nerve conduction studies/EMG | Nerve conduction study/EMG |
| Lumbar puncture | Lumbar puncture |
| **Medical knowledge** | |
| Localization | Localization |
| Diagnostic investigation | Diagnostic investigation |
| Formulation[b] | |

Competencies are presented out of order for the purpose of thematic comparison.
[a] Subcompetencies from Original Milestones that have been removed.
[b] Subcompetencies that have been moved to a different competency category.
[c] Subcompetencies that have been added to Milestones 2.0.

released in parallel with the Milestones 2.0 set for public comment and subsequently revised by the Work Group.

In addition to use in CCCs, the Supplemental Guide can be used for formative assessment of individual Milestones. For example, faculty assessing a resident's performance of lumbar puncture may refer to the proposed models and tools to plan an assessment encounter, although this list is not exhaustive. Faculty should also review Milestones 2.0 and behavioral examples prior to the assessment in order to understand what aspects of resident performance to observe. The guide can also be used after an assessment as a rubric for behavioral feedback. Similarly, residents can use the behavioral examples as models for self-assessment. In any of these instances, the provided resources can be used for further learning.

## The Future of the Milestones

The Milestones Project remains an iterative process that must balance the desire for validation and continuous improvement with the burden of implementing Milestone updates on training programs. In the 7 years since the implementation of the original Neurology Milestones, data have been gathered through Milestone reporting and the feedback processes described above. These data have yielded valuable information regarding usability, reliability, and face validity that have allowed for significant improvements in Milestones 2.0.[11,17,18] Further updates are anticipated; given the magnitude of change and significant progression toward construct and content validity, the interval between Milestones 2.0 and 3.0 will likely be longer than the 7 years of this initial cycle. That said, the study of Milestones 2.0 actively continues, and numerous opportunities will be available for feedback from stakeholders across the GME community. Other outcomes to be studied include the effect of competency-based assessment on patient care quality and future resident performance as independent practitioners.

## Discussion

On July 1, 2021, the implementation of Neurology Milestones 2.0 began. Whereas the work towards the realization of outcomes-based assessment in neurology education is far from complete, the implementation of Neurology Milestones 2.0 represents the next step towards this aim. Just as the original Milestones did not intend to include every skill a neurologist must know before independent practice, the Work Group recognizes that Milestones 2.0 does not include all competencies. However,

**Figure 2** Example of Supplemental Guide Section Corresponding to the Patient Care Subcompetency

| Patient Care 5: Diagnosis and Management of Neurologic Disorders in the Inpatient Setting<br>**Overall Intent:** To diagnose and manage patients with neurologic disorders in the emergency department and hospital units | |
|---|---|
| **Milestones** | **Examples** |
| **Level 1** *Identifies typical presentations of commonly encountered neurologic conditions* | • Describes that a patient presenting with acute focal neurologic deficits likely has an acute ischemic stroke |
| **Level 2** *Diagnoses commonly encountered neurologic conditions* | • Diagnoses a right middle cerebral artery territory ischemic stroke in a patient that presents with left hemiparesis and neglect and a normal head computerized tomography (CT) scan |
| *Develops an initial treatment plan for commonly encountered neurologic disorders* | • Begins intravenous immunoglobulin or plasma exchange therapy for a patient with Guillain-Barre Syndrome and institutes cardiac and respiratory monitoring |
| **Level 3** *Identifies atypical presentations of commonly encountered neurologic conditions* | • Considers the possibility of myasthenia gravis in an intensive care unit (ICU) patient with pneumonia who is unable to be weaned from mechanical ventilation, despite no previous neurologic history |
| *Individualizes management plan, ensuring the appropriate level of care throughout hospitalization and upon discharge* | • Arranges intubation and avoids aggressive blood pressure management in a patient with Guillain-Barre Syndrome who has a declining forced vital capacity and fluctuating hypertension<br>• Works with case management to discharge patient to an appropriately safe environment |
| **Level 4** *Diagnoses uncommon neurologic conditions* | • Diagnoses pituitary apoplexy in a patient who presents with thunderclap headache and bilateral ophthalmoparesis |
| *Adapts management plan based upon treatment response, disease progression, and complications of therapy* | • Applies an algorithmic approach to a patient with status epilepticus who does not improve despite initial therapy and escalates therapy in a timely fashion |
| **Level 5** *Identifies atypical presentations of uncommon neurologic conditions* | • Considers Creutzfeldt-Jakob disease in a patient presenting with falls and ataxia |
| *Leads the management of patients with complex and uncommon neurologic conditions* | • Initiates and modifies treatment in a patient with neurosarcoidosis based on disease response and/or progression |
| Assessment Models or Tools | • Case conference assessment<br>• Direct observation<br>• Medical record (chart) audit<br>• Multisource feedback<br>• Simulation |
| Curriculum Mapping | • |
| Notes or Resources | • Alpert NJ. *The Neurologic Diagnosis: A Practical Bedside Approach.* 2nd ed. Houston, TX: Springer; 2019. |

Corresponds to the patient care subcompetency in Figure 1B. Reproduced with permission from the Accreditation Council for Graduate Medical Education.[20]

the Milestones encompass the knowledge and behaviors of a well-rounded, thoroughly trained neurologist. At the individual program level, there is more work to be done to develop assessment instruments that inform learners, CCCs, and program directors on an individual resident's progress in achieving these Milestones and develop skills for independent practice. We hope the reduced complexity of Neurology Milestones 2.0 and addition of the new Supplemental Guide will empower programs to build and sustain a multisource assessment infrastructure to inform Milestone reporting. With this infrastructure in place and harmonized general competencies across specialties, it is expected that there will be a lower burden on individual programs to have to overhaul assessment tools with successive Milestone iterations. With Milestones 2.0, residents have an additional tool to guide them as they engage in self-directed learning and develop the skills of lifelong independent learning, self-monitoring, and practice improvement. At the ACGME, revision of subspecialty Milestones for neurology fellowships are underway as the Next Accreditation System enters its eighth year of iterative progress towards the vision of competency-based GME.


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Continued

## Appendix 1 *(continued)*

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