Neuroendovascular InterventionMilestones

The Accreditation Council for Graduate Medical Education



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Neuroendovascular Intervention Milestones

The Milestones are designed only for use in evaluation of fellows in the context of their participation in ACGME-accredited residency or fellowship programs. The Milestones provide a framework for the assessment of the development of the fellow in key dimensions of the elements of physician competency in a specialty or subspecialty. They neither represent the entirety of the dimensions of the six domains of physician competency, nor are they designed to be relevant in any other context.

**Neuroendovascular Intervention Milestones**

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American Board of Neurological Surgery

American Board of Psychiatry and Neurology

American Board of Radiology

ACGME Review Committees for Neurological Surgery, Neurology, and Radiology

Society of Neurological Surgeons

**Understanding Milestone Levels and Reporting**

This document presents the Milestones, which programs use in a semi-annual review of fellow performance, and then report to the ACGME. Milestones are knowledge, skills, attitudes, and other attributes for each of the ACGME Competencies organized in a developmental framework. The narrative descriptions are targets for resident/fellow performance throughout their educational program.

Milestones are arranged into levels. Tracking from Level 1 to Level 5 is synonymous with moving from novice to expert fellow in the specialty or subspecialty. For each reporting period, the Clinical Competency Committee will review the completed evaluations to select the milestone levels that best describe each learner’s current performance, abilities, and attributes for each subcompetency.

These levels *do not* correspond with post-graduate year of education. Depending on previous experience, a junior fellow may achieve higher levels early in his/her educational program just as a senior fellow may be at a lower level later in his/her educational program. There is no predetermined timing for a resident to attain any particular level. Fellows may also regress in achievement of their milestones. This may happen for many reasons, such as over scoring in a previous review, a disjointed experience in a particular procedure, or a significant act by the resident/fellow.

Selection of a level implies the resident/fellow substantially demonstrates the milestones in that level, as well as those in lower levels (see the diagram on page v).

**Additional Notes**

Level 4 is designed as a graduation *goal*but *does not* represent a graduation *requirement*. Making decisions about readiness for graduation and unsupervised practice is the purview of the program director. Furthermore, Milestones 2.0 include revisions and changes that preclude using Milestones as a sole assessment in high-stakes decisions (i.e., determination of eligibility for certification or credentialing). Level 5 is designed to represent an expert fellow whose achievements in a subcompetency are greater than the expectation. Milestones are primarily designed for formative, developmental purposes to support continuous quality improvement for individual learners, education programs, and the specialty. The ACGME and its partners will continue to evaluate and perform research on the Milestones to assess their impact and value.

Some milestone descriptions include statements about performing independently. These activities must occur in conformity to ACGME supervision guidelines as described in the Program Requirements, as well as to institutional and program policies. For example, a fellow who performs a procedure independently must, at a minimum, be supervised through oversight.

A Supplemental Guide is also available to provide the intent of each subcompetency, examples for each level, assessment methods or tools, and other available resources. The Supplemental Guide, like examples contained within the Milestones, is designed only to assist the program director and Clinical Competency Committee, and is not meant to demonstrate any required element or outcome.

Additional resources are available in the [Milestones](http://www.acgme.org/What-We-Do/Accreditation/Milestones/Overview) section of the ACGME website. Follow the links under “What We Do” at [www.acgme.org](http://www.acgme.org).

The diagram below presents an example set of milestones for one subcompetency in the same format as the ACGME Report Worksheet. For each reporting period, a fellow’s performance on the milestones for each subcompetency will be indicated by selecting the level of milestones that best describes that fellow’s performance in relation to those milestones.



Selecting a response box on the line in between levels indicates that milestones in lower levels have been substantially demonstrated as well as **some** milestones in the higher level(s).

Selecting a response box in the middle of a level implies that milestones in that level and in lower levels have been substantially demonstrated.

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| **Patient Care 1: Pre-Procedural Consultations** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Gathers a complete history and performs a physicalFormulates a pre-procedural assessment and plan, including risks, benefits, and alternatives, with guidance from a faculty member | Chooses pre-procedural laboratory and imaging studiesFormulates a pre-procedural assessment and plan with minimal guidance from a faculty member | Interprets pre-procedural imaging studiesIndependently formulates pre-procedural assessments and plans for common disorders | Adjusts procedural plan based upon pre-procedural laboratory and imaging resultsIndependently formulates pre-procedural assessments and plans for complex disorders | Mentors other learners in the pre-procedural consultationDevelops patient care protocols/teaching materials |
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| **Comments:** Not Yet AssessableNot Yet Completed Level 1 |

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| **Patient Care 2: Performance of Procedures** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Performs basic procedures (e.g., cerebral angiography, hemostasis, vascular access)Effectively uses basic image guidance (e.g., visualize needle tip with ultrasound) | Performs advanced basic procedures (e.g., spinal angiography, venous angiography, Wada test)Demonstrates basic catheter and wire skills | Performs moderately complex procedures (e.g., coiling of aneurysm, carotid stent, mechanical thrombectomy)Integrates catheter and wire skills with imaging of complex anatomy | Performs complex procedures (e.g., intracranial stent, flow diverter, liquid embolics)Integrates catheter and wire skills with advanced imaging guidance and device utilization | Develops new techniques or tools |
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| **Comments:** Not Yet AssessableNot Yet Completed Level 1 |

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| **Patient Care 3: Post-Procedural Care** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Manages routine post-procedural care with guidanceEvaluates post-procedural complications Generates reports with appropriate elements for coding | Manages post-procedural care with minimal guidanceManages minor post- procedural complicationsEfficiently generates clear and concise reports that do not require substantive correction | Formulates and implements post-procedural imaging and clinical follow-up for patients after basic proceduresManages major post- procedural complicationsEfficiently generates clear and concise reports that rarely require correction | Formulates and implements post-procedural imaging and clinical follow-up for patients after complex proceduresAnticipates and mitigates post-procedural complicationsGenerates tailored reports meeting the needs of the care provider and complex interventional reports with appropriate elements for coding | Mentors other learners in post-procedural care and management of complicationsDevelops a clinical pathway or guideline for post-procedural care |
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| **Comments:** Not Yet AssessableNot Yet Completed Level 1 |

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| **Medical Knowledge 1: Imaging and Procedural Anatomy** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Demonstrates knowledge of imaging anatomyIdentifies normal anatomy during procedures | Applies knowledge of anatomy to make common imaging diagnosesIdentifies anatomic variants during procedures | Applies knowledge of anatomy to make uncommon imaging diagnosesArticulates the implications of varying anatomy for procedural planning | Proficiently integrates knowledge of anatomic imaging with pathophysiology to formulate a diagnosisIdentifies post-operative anatomy and its implications for procedures | Proficiently integrates knowledge of anatomic imaging with pathophysiology to formulate a diagnosis and treatment plan at the expected level of a subspecialistDevelops simulation models or other resources |
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| **Comments:** Not Yet Completed Level 1Not Yet Assessable |

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| **Medical Knowledge 2: Physics and Imaging Technology** |
| Level 1  | Level 2 | Level 3 | Level 4 | Level 5 |
| Discusses the basic physics for imaging and image-guided interventionDiscusses imaging technology and image acquisition | Demonstrates knowledge of basic medical physics and radiobiology in imaging and image-guided interventionDemonstrates knowledge of basic image acquisition and image processing, and recognizes common imaging artifacts and technical problems | Applies knowledge of basic medical physics and radiobiology to imaging and image-guided interventionDemonstrates knowledge of instrument quality control and image reconstruction; troubleshoots for artifact reduction | Applies physical principles to optimize image quality, including dose reduction strategiesProficiently optimizes image acquisition and processing in collaboration with the technology/imaging team | Teaches physical principles to optimize image quality to other specialtiesPresents or publishes research on imaging technology |
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| **Comments:** Not Yet Completed Level 1Not Yet Assessable |

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| **Medical Knowledge 3: Pathophysiology and Treatment** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Demonstrates knowledge of pathophysiology of common conditions (e.g., stroke, ruptured aneurysm) | Demonstrates knowledge of pathophysiology and treatment of patients with common conditions | Demonstrates knowledge of pathophysiology and treatment of patients with complex conditions (e.g., arteriovenous [AV] fistula, arteriovenous malformation [AVM]) | Demonstrates knowledge of the pathophysiologic changes after treatment | Contributes to peer-reviewed literature on pathophysiology and/or treatment |
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| **Comments:** Not Yet AssessableNot Yet Completed Level 1 |

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| **Medical Knowledge 4: Pharmacology and Contrast** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Demonstrates basic knowledge of the pharmacologic and contrast agents used in endovascular surgical neuroradiology procedures | Demonstrates knowledge of dosing and drug choice for contrast agents, sedation drugs, and commonly used pharmacologic agents | Demonstrates knowledge of the indications, contraindications, side-effects, and complications of pharmacologic agents | Applies functional knowledge of pharmacology to endovascular surgical neuroradiology procedures and peri-procedural care | Develops pharmacologic protocols or departmental guidelines |
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| **Comments:** Not Yet AssessableNot Yet Completed Level 1 |

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| **Systems-Based Practice 1: Patient Safety** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Demonstrates knowledge of common patient safety eventsDemonstrates knowledge of how to report patient safety events | Identifies system factors that lead to patient safety eventsReports patient safety events through institutional reporting systems (simulated or actual) | Participates in analysis of patient safety events (simulated or actual)Participates in disclosure of patient safety events to patients and families (simulated or actual) | Conducts analysis of patient safety events and offers error prevention strategies (simulated or actual)Discloses patient safety events to patients and families (simulated or actual) | Actively engages teams and processes to modify systems to prevent patient safety eventsRole models or mentors others in the disclosure of patient safety events |
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| **Comments:** Not Yet Completed Level 1 |

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| **Systems-Based Practice 2: Quality Improvement** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Demonstrates knowledge of basic quality improvement methodologies and metrics | Describes local quality improvement initiatives | Participates in local quality improvement initiatives | Demonstrates the skills required to identify, develop, implement, and analyze a quality improvement project | Creates, implements, and assesses quality improvement initiatives at the institutional or community level |
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| **Comments:** Not Yet Completed Level 1 |

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| **Systems-Based Practice 3: System Navigation for Patient-Centered Care** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Demonstrates knowledge of care coordination in endovascular surgical neuroradiology imaging/proceduresIdentifies key elements for safe and effective transitions of care and hand-offsDemonstrates knowledge of population and community health needs and disparities | Coordinates care of patients in routine endovascular surgical neuroradiology imaging/procedures effectively using the roles of interprofessional team membersPerforms safe and effective transitions of care/hand-offs in routine clinical situationsIdentifies specific population and community health needs and inequities for the local population | Coordinates care of patients in complex endovascular surgical neuroradiology imaging/procedures effectively using the roles of interprofessional team membersPerforms safe and effective transitions of care/hand-offs in complex clinical situationsIdentifies local resources available to meet the needs of a patient population and community | Role models effective coordination of patient-centered care among different disciplines and specialtiesRole models safe and effective transitions of care/hand-offsParticipates in adapting the practice to provide for the needs of specific populations (actual or simulated) | Analyzes the process of care coordination and leads in the design and implementation of improvementsImproves quality of transitions of care to optimize patient outcomesLeads innovations and advocates for populations and communities with health care inequities |
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| **Comments:** Not Yet Completed Level 1 |

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| **Systems-Based Practice 4: Physician Role in Health Care Systems** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Identifies key components of the complex health care system (e.g., hospital, finance, personnel, technology)Describes the mechanisms for reimbursement, including types of payors | Describes how components of a complex health care system are interrelated, and how this impacts patient careStates relative cost of common procedures | Discusses how individual practice affects the broader system (e.g., length of stay, readmission rates, clinical efficiency)Describes the technical and professional components of neurointerventional procedural costs | Manages various components of the complex health care system to provide efficient and effective patient care and transitions of careDescribes the endovascular surgical neuroradiology revenue cycle and measurements of productivity (e.g., relative value units) | Advocates for or leads systems change that enhances high-value, efficient, and effective patient care and transitions of careParticipates in health policy advocacy activities |
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| **Comments:** Not Yet Completed Level 1 |

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| **Systems-Based Practice 5: Radiation Safety** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Demonstrates knowledge of the mechanisms of radiation injury and the ALARA (“as low as reasonably achievable”) concept | Accesses resources to determine exam-specific average radiation dose information | Communicates the relative risk of exam-specific radiation exposure to patients and practitioners | Applies principles of ALARA in daily practice | Creates, implements, and assesses radiation safety initiatives at the institutional level |
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| **Comments:** Not Yet Completed Level 1 |

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| **Practice-Based Learning and Improvement 1: Evidence-Based and Informed Practice and Technology Assessment** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Demonstrates how to access and use available evidence to guide routine patient careDiscusses the evolution of device or other technology development | Articulates clinical questions and elicits patient preferences and values to guide evidence-based careDiscusses regulatory framework (e.g., FDA, IRB, HDE) of a device and its consent and use | Locates and applies the best available evidence, integrated with patient preference and values, to care for complex patientsDiscusses evidence for currently available devices, limitations for use, and reporting requirements | Critically appraises conflicting evidence to guide care, tailored to the individual patientCritically assesses new technology and available evidence | Coaches others to critically appraise and apply evidence for complex patients, and/or participates in the development of guidelines |
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| **Comments:** Not Yet Completed Level 1 |

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| **Practice-Based Learning and Improvement 2: Reflective Practice and Commitment to Professional Growth** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Accepts responsibility for professional development by establishing goalsIdentifies factors that contribute to gap(s) between expectations and actual performanceActively seeks opportunities to improve performance | Is receptive to performance data and feedback and uses them to inform goalsAnalyzes and reflects on factors that contribute to gap(s) between expectations and actual performanceDesigns and implements a learning plan, with prompting | Episodically seeks performance data and feedback with humility and adaptabilityAnalyzes, reflects on, and institutes behavioral change(s) to narrow the gap(s) between expectations and actual performanceDesigns and implements a learning plan independently | Consistently seeks performance data and feedback with humility and adaptabilityAnalyzes effectiveness of behavioral changes, where appropriate, and considers alternatives in narrowing the gap(s) between expectations and actual performanceUses performance data to measure the effectiveness of the learning plan, and improves it when necessary | Coaches other learners to consistently seek performance data and feedbackCoaches others on reflective practice Facilitates the design and implements learning plans for others |
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| **Comments:** Not Yet Completed Level 1 |

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| **Professionalism 1: Professional Behavior and Ethical Principles** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Demonstrates knowledge of expectations for professional behavior and describes how to appropriately report professional lapsesDemonstrates knowledge of the ethical principles underlying informed consent, surrogate decision making, advance directives, confidentiality, error disclosure, and stewardship of limited resources | Demonstrates insight into professional behavior in routine situations and takes responsibility for own professionalism lapsesAnalyzes straightforward situations using ethical principles | Demonstrates professional behavior in complex or stressful situationsRecognizes need to seek help in managing and resolving complex ethical situations | Recognizes situations that may trigger professionalism lapses and intervenes to prevent lapses in oneself and othersRecognizes and uses appropriate resources for managing and resolving ethical dilemmas as needed (e.g., ethics consultations, literature review, risk management/legal consultation) | Coaches others when their behavior fails to meet professional expectationsIdentifies and seeks to address system-level factors that induce or exacerbate ethical problems or impede their resolution |
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| **Comments:** Not Yet Completed Level 1 |

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| **Professionalism 2: Accountability/Conscientiousness** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Responds promptly to requests or reminders to complete tasks and responsibilities | Performs tasks and responsibilities in a timely manner to ensure the needs of patients, teams, and systems are met in routine situations | Performs tasks and responsibilities in a timely manner to ensure the needs of patients, teams, and systems are met in complex or stressful situations | Recognizes and raises awareness of situations that may impact others’ ability to complete tasks and responsibilities in a timely manner | Takes ownership of system outcomes |
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| **Comments:** Not Yet Completed Level 1 |

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| **Professionalism 3: Self-Awareness and Help Seeking** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Recognizes status of personal and professional well-being, with assistance, and is aware of available resourcesRecognizes limits in the knowledge/skills of oneself or the team, with assistance | Independently recognizes status of personal and professional well-being using available resources when appropriateIndependently recognizes limits in the knowledge/skills of oneself or the team and demonstrates appropriate help-seeking behaviors | With assistance, proposes a plan to optimize personal and professional well-beingWith assistance, proposes a plan to remediate or improve limits in the knowledge/skills of oneself or the team | Independently develops a plan to optimize personal and professional well-beingIndependently develops a plan to remediate or improve limits in the knowledge/skills of oneself or the team | Coaches others when emotional responses or limitations in knowledge/skills do not meet professional expectations |
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| **Comments:** Not Yet Completed Level 1 |

This subcompetency is not intended to evaluate a fellow’s well-being. Rather, the intent is to ensure that each fellow has the fundamental knowledge of factors that affect well-being, the mechanisms by which those factors affect well-being, and available resources and tools to improve well-being.

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| **Interpersonal and Communication Skills 1: Patient- and Family-Centered Communication** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Accurately communicates own role within the health care systemIdentifies the need to adjust communication strategies based on assessment of the patient/patient’s family’s expectations and understanding of their health status and treatment options | Identifies barriers to effective communication (e.g., language, health literacy, cultural)Organizes and initiates communication with the patient/patient’s family by clarifying expectations and verifying understanding of the clinical situation | Identifies biases that hinder effective communicationWith guidance, sensitively and compassionately delivers medical information, elicits patient goals and preferences, and acknowledges uncertainty and conflict | Actively minimizes communication barriersIndependently uses shared decision making to align patient goals and preferences with treatment options to make a personalized care plan | Coaches other learners to minimize communication barriersCoaches other learners in shared decision making |
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| **Comments:** Not Yet Completed Level 1 |

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| **Interpersonal and Communication Skills 2: Interprofessional and Team Communication** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Respectfully receives a consultation requestUses language that values all members of the health care team | Clearly and concisely responds to a consultation requestCommunicates information effectively with all health care team members | Checks understanding of recommendations when providing consultationUses active listening to adapt communication style to fit team needs | Coordinates recommendations from different members of the health care team to optimize patient careSolicits and communicates feedback to other members of the health care team | Role models flexible communication strategies that value input from all health care team members, resolving conflict when needed |
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| **Comments:** Not Yet Completed Level 1 |

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| **Interpersonal and Communication Skills 3: Communication within Health Care Systems** |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
| Demonstrates knowledge of institutional communications policies | Communicates appropriately as required by institutional policy | Communicates systems concerns in a respectful manner | Communicates clear and constructive suggestions to improve systems | Facilitates dialogue regarding systems issues among larger community stakeholders (institution, health care system, field) |
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| **Comments:** Not Yet Completed Level 1 |