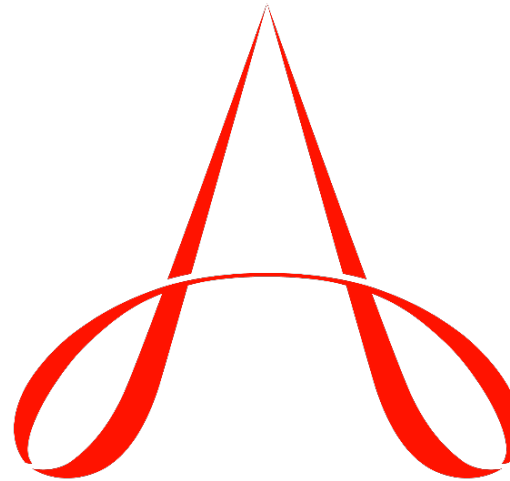# Endovascular Surgical Neuroradiology Milestones

The Accreditation Council for Graduate Medical Education

ACGME

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Second Revision: April 2021
First Revision: February 2014

Endovascular Surgical Neuroradiology 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.

Endovascular Surgical Neuroradiology 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 section of the ACGME website. Follow the links under "What We Do" at 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.

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 care	Articulates clinical questions and elicits patient preferences and values in order to guide evidence-based care	Locates and applies the best available evidence, integrated with patient preference and values, to care for complex patients	Critically appraises conflicting evidence to guide care, tailored to the individual patient	Coaches others to critically appraise and apply evidence for complex patients; and/or participates in the development of guidelines
Discusses the evolution of device or other technology development	Discusses regulatory framework (e.g., FDA, IRB, HDE) of a device and its consent and use	Discusses evidence for currently available devices, limitations for use, and reporting requirements	Critically assesses new technology and available evidence	

Comments:

Not Yet Completed Level 1 ☐

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

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).

Patient Care 1: Pre-Procedural Consultations

Level 1	Level 2	Level 3	Level 4	Level 5
Gathers a complete history and performs a physical	Chooses pre-procedural laboratory and imaging studies	Interprets pre-procedural imaging studies	Adjusts procedural plan based upon pre-procedural laboratory and imaging results	Mentors other learners in the pre-procedural consultation
Formulates a pre-procedural assessment and plan, including risks, benefits, and alternatives, with guidance from a faculty member	Formulates a pre-procedural assessment and plan with minimal guidance from a faculty member	Independently formulates pre-procedural assessments and plans for common disorders	Independently formulates pre-procedural assessments and plans for complex disorders	Develops patient care protocols/teaching materials

Comments:

Not Yet Completed Level 1 ☐
Not Yet Assessable ☐

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

Comments:

Not Yet Completed Level 1 ☐
Not Yet Assessable ☐

Patient Care 3: Post-Procedural Care

Level 1	Level 2	Level 3	Level 4	Level 5
Manages routine post-procedural care with guidance	Manages post-procedural care with minimal guidance	Formulates and implements post-procedural imaging and clinical follow-up for patients after basic procedures	Formulates and implements post-procedural imaging and clinical follow-up for patients after complex procedures	Mentors other learners in post-procedural care and management of complications
Evaluates post-procedural complications	Manages minor post-procedural complications	Manages major post-procedural complications	Anticipates and mitigates post-procedural complications	Develops a clinical pathway or guideline for post-procedural care
Generates reports with appropriate elements for coding	Efficiently generates clear and concise reports that do not require substantive correction	Efficiently generates clear and concise reports that rarely require correction	Generates tailored reports meeting the needs of the care provider and complex interventional reports with appropriate elements for coding	

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Comments:

Not Yet Completed Level 1 ☐
Not Yet Assessable ☐

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

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 intervention	Demonstrates knowledge of basic medical physics and radiobiology in imaging and image-guided intervention	Applies knowledge of basic medical physics and radiobiology to imaging and image-guided intervention	Applies physical principles to optimize image quality, including dose reduction strategies	Teaches physical principles to optimize image quality to other specialties
Discusses imaging technology and image acquisition	Demonstrates knowledge of basic image acquisition and image processing, and recognizes common imaging artifacts and technical problems	Demonstrates knowledge of instrument quality control and image reconstruction; troubleshoots for artifact reduction	Proficiently optimizes image acquisition and processing in collaboration with the technology/imaging team	Presents or publishes research on imaging technology

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Comments:

Not Yet Completed Level 1 ☐
Not Yet Assessable ☐

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
☐	☐	☐	☐	☐	☐	☐	☐	☐

Comments:

Not Yet Completed Level 1   ☐
Not Yet Assessable   ☐

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 Completed Level 1 ☐

Not Yet Assessable ☐

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

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   ☐

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/procedures	Coordinates care of patients in routine endovascular surgical neuroradiology imaging/procedures effectively using the roles of interprofessional team members	Coordinates care of patients in complex endovascular surgical neuroradiology imaging/procedures effectively using the roles of interprofessional team members	Role models effective coordination of patient-centered care among different disciplines and specialties	Analyzes the process of care coordination and leads in the design and implementation of improvements
Identifies key elements for safe and effective transitions of care and hand-offs	Performs safe and effective transitions of care/hand-offs in routine clinical situations	Performs safe and effective transitions of care/hand-offs in complex clinical situations	Role models safe and effective transitions of care/hand-offs	Improves quality of transitions of care to optimize patient outcomes
Demonstrates knowledge of population and community health needs and disparities	Identifies specific population and community health needs and inequities for the local population	Identifies local resources available to meet the needs of a patient population and community	Participates in adapting the practice to provide for the needs of specific populations (actual or simulated)	Leads innovations and advocates for populations and communities with health care inequities

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Comments:

                                                            Not Yet Completed Level 1   ☐

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 how components of a complex health care system are interrelated, and how this impacts patient care	Discusses how individual practice affects the broader system (e.g., length of stay, readmission rates, clinical efficiency)	Manages various components of the complex health care system to provide efficient and effective patient care and transitions of care	Advocates for or leads systems change that enhances high-value, efficient, and effective patient care and transitions of care
Describes the mechanisms for reimbursement, including types of payors	States relative cost of common procedures	Describes the technical and professional components of neurointerventional procedural costs	Describes the endovascular surgical neuroradiology revenue cycle and measurements of productivity (e.g., relative value units)	Participates in health policy advocacy activities

Comments:

Not Yet Completed Level 1 ☐

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   ☐

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 care	Articulates clinical questions and elicits patient preferences and values to guide evidence-based care	Locates and applies the best available evidence, integrated with patient preference and values, to care for complex patients	Critically appraises conflicting evidence to guide care, tailored to the individual patient	Coaches others to critically appraise and apply evidence for complex patients, and/or participates in the development of guidelines
Discusses the evolution of device or other technology development	Discusses regulatory framework (e.g., FDA, IRB, HDE) of a device and its consent and use	Discusses evidence for currently available devices, limitations for use, and reporting requirements	Critically assesses new technology and available evidence	

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Comments:

Not Yet Completed Level 1 ☐

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 goals	Is receptive to performance data and feedback and uses them to inform goals	Episodically seeks performance data and feedback with humility and adaptability	Consistently seeks performance data and feedback with humility and adaptability	Coaches other learners to consistently seek performance data and feedback
Identifies factors that contribute to gap(s) between expectations and actual performance	Analyzes and reflects on factors that contribute to gap(s) between expectations and actual performance	Analyzes, reflects on, and institutes behavioral change(s) to narrow the gap(s) between expectations and actual performance	Analyzes effectiveness of behavioral changes, where appropriate, and considers alternatives in narrowing the gap(s) between expectations and actual performance	Coaches others on reflective practice
Actively seeks opportunities to improve performance	Designs and implements a learning plan, with prompting	Designs and implements a learning plan independently	Uses performance data to measure the effectiveness of the learning plan, and improves it when necessary	Facilitates the design and implements learning plans for others

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Comments:

Not Yet Completed Level 1   ☐

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 lapses	Demonstrates insight into professional behavior in routine situations and takes responsibility for own professionalism lapses	Demonstrates professional behavior in complex or stressful situations	Recognizes situations that may trigger professionalism lapses and intervenes to prevent lapses in oneself and others	Coaches others when their behavior fails to meet professional expectations
Demonstrates knowledge of the ethical principles underlying informed consent, surrogate decision making, advance directives, confidentiality, error disclosure, and stewardship of limited resources	Analyzes straightforward situations using ethical principles	Recognizes need to seek help in managing and resolving complex ethical situations	Recognizes and uses appropriate resources for managing and resolving ethical dilemmas as needed (e.g., ethics consultations, literature review, risk management/legal consultation)	Identifies and seeks to address system-level factors that induce or exacerbate ethical problems or impede their resolution

Comments:

Not Yet Completed Level 1 ☐

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

Comments:

Not Yet Completed Level 1 ☐

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 resources	Independently recognizes status of personal and professional well-being using available resources when appropriate	With assistance, proposes a plan to optimize personal and professional well-being	Independently develops a plan to optimize personal and professional well-being	Coaches others when emotional responses or limitations in knowledge/skills do not meet professional expectations
Recognizes limits in the knowledge/skills of oneself or the team, with assistance	Independently recognizes limits in the knowledge/skills of oneself or the team and demonstrates appropriate help-seeking behaviors	With assistance, proposes a plan to remediate or improve limits in the knowledge/skills of oneself or the team	Independently develops a plan to remediate or improve limits in the knowledge/skills of oneself or the team	

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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.

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 system	Identifies barriers to effective communication (e.g., language, health literacy, cultural)	Identifies biases that hinder effective communication	Actively minimizes communication barriers	Coaches other learners to minimize communication barriers
Identifies 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	Organizes and initiates communication with the patient/patient's family by clarifying expectations and verifying understanding of the clinical situation	With guidance, sensitively and compassionately delivers medical information, elicits patient goals and preferences, and acknowledges uncertainty and conflict	Independently uses shared decision making to align patient goals and preferences with treatment options to make a personalized care plan	Coaches other learners in shared decision making
☐	☐	☐	☐	☐	☐	☐	☐	☐

Comments:
Not Yet Completed Level 1   ☐

Interpersonal and Communication Skills 2: Interprofessional and Team Communication				
Level 1	Level 2	Level 3	Level 4	Level 5
Respectfully receives a consultation request	Clearly and concisely responds to a consultation request	Checks understanding of recommendations when providing consultation	Coordinates recommendations from different members of the health care team to optimize patient care	Role models flexible communication strategies that value input from all health care team members, resolving conflict when needed
Uses language that values all members of the health care team	Communicates information effectively with all health care team members	Uses active listening to adapt communication style to fit team needs	Solicits and communicates feedback to other members of the health care team	

Comments:

Not Yet Completed Level 1 ☐

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)
☐	☐	☐	☐	☐	☐	☐	☐	☐

Comments:

Not Yet Completed Level 1   ☐