

The Nuclear Medicine Milestone Project

The Milestones provide a framework for the assessment of the development of the resident physician in key dimensions of the elements of physician competency in a specialty or subspecialty. The Milestones are designed only for use in evaluation of resident physicians in the context of their participation in Accreditation Council for Graduate Medical Education (ACGME)-accredited residency or fellowship programs. They neither represent the entirety of the dimensions of the 6 domains of physician competency, nor are they designed to be relevant in any other context.

Milestone Reporting

This document presents Milestones designed for programs to use in semiannual review of resident performance and reporting to the ACGME. Milestones are knowledge, skills, attitudes, and other attributes for each of the ACGME competencies organized in a developmental framework from less to more advanced. They are descriptors and targets for resident performance as a resident moves from entry into residency through graduation. In the initial years of implementation, the Review Committee will examine Milestone performance data for each program's residents as 1 element in the Next Accreditation System (NAS) to determine whether residents overall are progressing.

For each period, review and reporting will involve selecting Milestone levels that best describe a resident's current performance and attributes. Milestones are arranged into numbered levels. Tracking from Level 1 to Level 5 is synonymous with moving from novice to expert. These levels do not correspond with postgraduate year of education.

Selection of a level implies that the resident substantially demonstrates the Milestones in that level, as well as those in lower levels (see FIGURE).

Level 1: The resident demonstrates Milestones expected of an incoming resident.

Level 2: The resident is advancing and demonstrates additional Milestones, but is not yet performing at a midresidency level.

Level 3: The resident continues to advance and demonstrate additional Milestones, consistently including the majority of Milestones targeted for residency.

Level 4: The resident has advanced so that he or she now substantially demonstrates the Milestones targeted for residency. This level is designed as the graduation target.

Level 5: The resident has advanced beyond performance targets set for residency and is demonstrating aspirational goals which might describe the performance of someone who has been in practice for several years. It is expected that only a few exceptional residents will reach this level.

Additional Notes

Level 4 is designed as the graduation *target* and *does not* represent a graduation *requirement*. Making decisions about readiness for graduation is the purview of the residency program director. Study of Milestone performance data will be required before the ACGME and its partners will be able to determine whether Milestones in the first 4 levels appropriately represent the developmental framework, and whether Milestone data are of sufficient quality to be used for high-stakes decisions.

Some Milestone descriptions include statements about performing independently. These activities must conform to ACGME supervision guidelines, as well as institutional and program policies. For example, a resident who performs a procedure independently must, at a minimum, be supervised through oversight.

Examples are provided with some Milestones. Please note that the examples are not the required element or outcome; they are provided as a way to share the intent of the element. Answers to Frequently Asked Questions about the NAS and Milestones are available on the ACGME's website.

The FIGURE presents an example set of Milestones for 1 subcompetency in the same format as the Milestone Report Form. For each reporting period, a resident's performance on the Milestones for each subcompetency will be indicated by:

- selecting the level of Milestones that best describes that resident's performance in relation to the Milestones, or
- for Patient Care and Medical Knowledge Milestones, selecting the option that says the resident has "Not yet rotated," or
- for Interpersonal and Communication Skills, Practice-Based Learning and Improvement, Professionalism, and Systems-Based Practice Milestones, selecting the option that says the resident has "Not yet achieved Level 1."

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Professional Ethics and Accountability — Professionalism				
Level 1	Level 2	Level 3	Level 4	Level 5
• Demonstrates integrity, respect, honesty and compassion • Timely for assigned rotations, reports, state licensure and duties	• Honest and truthful in all circumstances. Reliably ethical • Accountable in completion of duties, records and patient care • Sensitive and responsive to diverse patient population and needs, regardless of gender, age, race, sexual orientation, religion, or disabilities	• Acknowledges errors with Program Director, faculty, and/or patients • Takes on responsibility related to learning, coordination of care, patient care, Chartered Quality Institute (CQI), and compliance issues	• Committed to self-improvement. Responds well to constructive criticism • Patient needs supersede self-interest. Advocates for quality patient care • Operates professionally and independently in various educational and patient care environments	• Role model for honesty, integrity, professionalism and compassionate patient care • Demonstrates leadership in the department and professional organizations
☐	☐	☐	☐	☐
Comments: Not yet achieved 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).

FIGURE | EXAMPLE SET OF MILESTONES FOR 1 SUBCOMPETENCY IN THE ACGME MILESTONE REPORT FORM

NUCLEAR MEDICINE MILESTONES				
Diagnostic: General Nuclear Medicine, Cardiovascular, and Molecular Imaging (Patient Evaluation, Procedure Selection, Monitoring, and Interpretation)—Patient Care 1				
Level 1	Level 2	Level 3	Level 4	Level 5
- Performs focused patient evaluation - Is familiar with routine nuclear medicine procedures, common indications, and contraindications - Recognizes normal physiologic distribution of commonly used radiopharmaceuticals	- Proposes procedure, patient preparation, and basic procedure modification based on examination request and patient information - Recognizes normal physiologic distribution of less common radiopharmaceuticals - Performs image correlation and forms a preliminary impression	- Synthesizes patient information and selects appropriate procedures for routine cases - Assesses completion of and accurately interprets procedures done for uncomplicated cases	- Synthesizes patient information and selects appropriate procedure for complex, less common cases - Assesses completion of and accurately interprets procedures done for complex or less common cases	- Develops or modifies protocol(s) for nuclear medicine procedures - Presents or publishes nuclear medicine research in peer-reviewed media - Independently acts as a consultant in an interdisciplinary conference
Cardiovascular Nuclear Medicine-Stress Testing: Patient Evaluation and Procedure Monitoring—Patient Care 2				
Level 1	Level 2	Level 3	Level 4	Level 5
- Performs targeted patient evaluation - Is familiar with the range of cardiac stress protocols	- Is familiar with electrocardiogram interpretation and stress monitoring, and knows criteria for procedure termination - Recognizes adequate/inadequate stress and indications for procedure termination or rescheduling	- Knows common contraindications and understands when to select various forms of stress testing - Recognizes and manages common procedure complications	Recognizes and manages less common/complex procedure complications	Independently acts as a consultant in a cardiovascular nuclear medicine interdisciplinary conference
Therapy: Radioiodine for Benign Thyroid Disease—Patient Evaluation, Procedure Selection, Procedure Performance, and Follow-Up—Patient Care 3				
Level 1	Level 2	Level 3	Level 4	Level 5
- Familiar with patient preparation, indications, contraindications, and radiation safety precautions - Performs initial patient evaluation	- Identifies relevant patient information and confirms patient preparation - Confirms therapeutic procedure setup and technique	Synthesizes relevant patient information, formulates therapeutic plan, performs the procedure, and recommends follow-up strategies for routine clinical situations	Synthesizes relevant patient information, formulates therapeutic plan, performs the procedure, and recommends follow-up strategies for complicated/less common situations	Independently acts as a consultant in an interdisciplinary conference
Therapy: Radioiodine for Thyroid Malignancy—Patient Evaluation, Procedure Selection, Procedure Performance, and Follow-Up—Patient Care 4				
Level 1	Level 2	Level 3	Level 4	Level 5
- Is familiar with patient preparation, indications, contraindications, and radiation safety precautions - Performs initial patient evaluation	Confirms patient preparation and requests additional studies/consultations as needed	Synthesizes relevant patient information, formulates therapeutic plan, performs the procedure, and recommends follow-up strategies for routine clinical situations	Synthesizes relevant patient information, formulates therapeutic plan, performs the procedure, and recommends follow-up strategies for complicated/less common situations	Independently acts as a consultant in an interdisciplinary conference

Therapy: Parenteral—Patient Evaluation, Procedure Selection, Procedure Performance, and Follow-Up—Patient Care 5				
Level 1	Level 2	Level 3	Level 4	Level 5
- Is familiar with patient preparation, indications, contraindications, and radiation safety precautions - Performs initial patient evaluation	- Confirms procedure setup, regulatory compliance, and technique for therapy administration - Confirms patient preparation and requests additional studies/consultations as needed	Synthesizes relevant patient information, formulates therapeutic plan, performs the procedure, and recommends follow-up strategies for uncomplicated clinical situations	Synthesizes relevant patient information, formulates therapeutic plan, performs the procedure, and recommends follow-up strategies for complicated/less common clinical situations	Independently acts as a consultant at an interdisciplinary conference
Physiology and Pathophysiology—Medical Knowledge 1				
Level 1	Level 2	Level 3	Level 4	Level 5
Knows basic physiology and pathophysiology of common diseases	- Understands physiologic basis for patient preparation - Explains imaging findings of common diseases based on knowledge of physiology and pathophysiology	Understands physiologic basis for pharmacologic interventions	Explains imaging findings of complex and less common diseases based on knowledge of physiology and pathophysiology	Presents or publishes nuclear medicine research in peer-reviewed media
Anatomic Imaging—Medical Knowledge 2				
Level 1	Level 2	Level 3	Level 4	Level 5
Knows basic normal anatomy for imaging	Knows normal cross sectional anatomy, common anatomic variants, and commonly encountered abnormalities	Applies knowledge of anatomy to correlative, functional, and hybrid imaging	Knows less common anatomic variants, less common abnormalities, and critical findings	Teaches anatomic imaging to junior residents, medical students, and technologists
Instrumentation—Medical Knowledge 3				
Level 1	Level 2	Level 3	Level 4	Level 5
Has basic knowledge of instrumentation	Understands basic image acquisition and image processing, and recognizes common imaging artifacts and technical problems	Demonstrates knowledge of instrument quality control and image reconstruction	Works with technologist to optimize image acquisition and processing	Presents or publishes instrumentation research in peer-reviewed media
Radiopharmaceuticals and Molecular Agents—Medical Knowledge 4				
Level 1	Level 2	Level 3	Level 4	Level 5
Is familiar with routine radiopharmaceuticals and the Tracer principle	Recognizes abnormal radiopharmaceutical distribution for routine procedures	Is familiar with basic radiopharmacy operations and routine quality control	- Recognizes abnormal radiopharmaceutical distribution for less common procedures - Is aware of emerging radiopharmaceuticals that are near Food and Drug Administration approval	Demonstrates current knowledge of emerging radiopharmaceuticals and other molecular agents

Medical Physics, Mathematics, and Radiation Biology—Medical Knowledge 5				
Level 1	Level 2	Level 3	Level 4	Level 5
Knows basic physics for nuclear medicine	Understands basic medical physics, mathematics, and radiobiology in nuclear medicine	Knows basic medical physics and radiobiology for correlative imaging	Knows radiation dose optimization to include dose reduction strategies	Calculates radiation dose using the Medical Internal Radiation Dose approach and International Commission of Radiological Protection tables
Regulatory Requirements—Medical Knowledge 6				
Level 1	Level 2	Level 3	Level 4	Level 5
Is familiar with regulatory agencies	Knows laws and regulations regarding the medical use of radioactive materials	- Understands and applies laws and regulations regarding the medical use of radioactive materials - Understands the composition and function of the Radiation Safety Committee and the responsibilities of the Radiation Safety Officer	- Understands the purpose and functions of a radiation safety program - Understands the process for reportable or recordable incidents - Is familiar with The Joint Commission, NRC, and state radiation safety inspection processes	Is capable of participating with a regulatory committee, such as the Radiation Use Committee or Radiation Safety Committee
Radiation Protection, Patient Safety, and Procedural Safety—Medical Knowledge 7				
Level 1	Level 2	Level 3	Level 4	Level 5
- Knows basic radiation protection concepts and basic procedural safety in nuclear medicine - Understands universal precautions, including hand washing and sterile injection technique - Aware of the importance of fall prevention	- Understands radiation protection concepts in nuclear medicine and correlative imaging - Understands appropriate use of “time-out” procedure - Knows how to ensure that the right patient has the right study at the right time in the right setting	- Uniformly practices ALARA principles for patients, family, staff, and public - Knows more complex concepts of procedural safety and contraindications	- Understands prevention of procedural complications for nuclear medicine and correlative imaging studies - Knows how to manage procedural complications	- Demonstrates excellent understanding of radiation protection and/or procedural safety - Implements new safety procedures and quality control measures impacting patient care

Computer Systems—Systems-Based Practice 1				
Level 1	Level 2	Level 3	Level 4	Level 5
Accesses clinical computer systems; is familiar with word processing and spreadsheet programs	- Retrieves basic patient information from the electronic health record; is able to use the basic functions of picture archiving and communication system (PACs) and voice recognition systems - Understands Health Insurance Portability and Accountability Act policies and appropriate use concepts	Retrieves complex patient information from the electronic health record; is able to use the advanced functions of PACs and voice recognition systems	Is familiar with the basic functions of the billing systems	Recommends changes to computer systems/records to provide additional useful functionality
Economics—Systems-Based Practice 2				
Level 1	Level 2	Level 3	Level 4	Level 5
Has a basic understanding of the advantages and disadvantages of different payment systems	- Has a basic understanding of the economics of inpatient versus outpatient care, and the impact of quality improvement incentives - Develops understanding of relative cost per procedure	Has a basic practical understanding of the precertification process, radiology benefits managers, structured computer-based order entry systems, and Medicare/Medicaid procedure and report requirements	Has an advanced practical understanding of the precertification process, radiology benefits managers, structured computer-based order entry systems, and Medicare/Medicaid procedure and report requirements	Has a basic understanding of current state and national health care policies and their implications
Self-Directed Learning and Understanding Scientific Studies—Practice-Based Learning and Improvement 1				
Level 1	Level 2	Level 3	Level 4	Level 5
- Acknowledges gaps in personal knowledge and asks for feedback - Uses information technology to optimize learning - Describes basic concepts in clinical epidemiology and biostatistics	- Assesses performance and develops a learning plan with some external assistance - Uses published review articles or guidelines to review common practice topics - Evaluates study design by level of evidence and identifies sources of bias	- Selects appropriate evidence-based information to answer specific questions while providing care - Critically evaluates scientific literature	- Performs mostly self-directed learning without external guidance - Cites evidence supporting common diagnostic and therapeutic algorithms and strategies	- Incorporates practice change based upon new evidence - Independently teaches and assesses evidence-based medicine techniques
Implements Quality Improvement Project—Practice-Based Learning and Improvement 2				
Level 1	Level 2	Level 3	Level 4	Level 5
Identifies problems in health care delivery	Begins working on a quality improvement project either as an individual or team member	Continues to develop a quality improvement project, employing methods to measure and analyze the data	Completes a quality improvement project and displays effective teamwork skills	Develops and leads complex quality improvement projects and is able to lead a root cause analysis

Professional Ethics and Accountability—Professionalism				
Level 1	Level 2	Level 3	Level 4	Level 5
▪ Demonstrates integrity, respect, honesty, and compassion ▪ Is timely for assigned rotations, reports, state licensure, and duties	▪ Is honest and truthful in all circumstances; is reliably ethical ▪ Is accountable in completion of duties, records, and patient care ▪ Is sensitive and responsive to diverse patient population and needs, regardless of gender, age, race, sexual orientation, religion, or disabilities	▪ Acknowledges errors with program director, faculty members, and/or patients ▪ Takes on responsibility related to learning, coordination of care, patient care, Chartered Quality Institute, and compliance issues	▪ Is committed to self-improvement; responds well to constructive criticism ▪ Patient needs supersede self-interest; advocates for quality patient care ▪ Operates professionally and independently in various educational and patient care environments	▪ Role models honesty, integrity, professionalism, and compassionate patient care ▪ Demonstrates leadership in the department and professional organizations
Patient Communications—Interpersonal and Communications Skills 1				
Level 1	Level 2	Level 3	Level 4	Level 5
▪ Creates an ethically sound relationship with patients and families ▪ Learns to obtain informed consent	▪ Learns to perform effective interviews and to educate patients and their families ▪ Obtains informed consent	▪ Performs effective interviews with patients and families ▪ Educates patients and families, including explaining procedure(s) in an understandable and compassionate manner	▪ Teaches junior residents how to obtain informed consent, communicate effectively, perform effective interviews with patients, and educate patients' families	▪ Role models effective patient and family communications
Health Care Team—Interpersonal and Communications Skills 2				
Level 1	Level 2	Level 3	Level 4	Level 5
▪ Communicates clearly and effectively and works well with all members of the health care team	▪ Communicates results of routinely performed nuclear medicine procedures in a clear and concise fashion, both verbally and in the written procedure report	▪ Discusses and advises the referring health care provider(s) about the appropriateness of a procedure in routine clinical situations ▪ Communicates results of complex, less common nuclear medicine procedures in a clear and concise fashion, both verbally and in the written procedure report	▪ Discusses and advises the referring health care provider(s) about the appropriateness of a procedure in complex, less common situations	▪ Independently acts as a consultant during interdisciplinary conferences