# Molecular Genetic Pathology Milestones

The Accreditation Council for Graduate Medical Education



Implementation Date July 1, 2021 Second Revision: May 2021 First Revision: October 2014

## Molecular Genetic Pathology 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 competence 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.

#### **Molecular Genetic Path Milestones**

## **Work Group**

Jesse Cox, MD, PhD

Laura Edgar, EdD, CAE

Mark Ewalt, MD

Kevin Fisher, MD, PhD

Jane Gibson, PhD, FACMG

Shuko Harada, MD

Karen Kaul, MD

Cindy McCloskey, MD

Shirly Meade, C-TAGME

Keyur Patel, MD, PhD

Jessica Thomas, MD, PhD, MPH

Cindy Vnencak-Jones, PhD, FACMG

Cecilia Yeung, MD, ABP - AP/CP, HP, MGP

Linsheng Zhang, MD, PhD

The ACGME would like to thank the following organizations for their continued support in the development of the Milestones:

American Board of Medical Genetics and Genomics

American Board of Pathology

ACGME Review Committee for Medical Genetics and Genomics

ACGME Review Committee for Pathology

### **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 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 fellow 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 fellow.

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

#### **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.

Examples are provided for some milestones within this document. Please note: the examples are not the required element or outcome; they are provided as a way to share the intent of the element.

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.

Supplemental Guides and other resources are available on the Milestones page of each specialty section of the ACGME website. On <a href="https://www.acgme.org">www.acgme.org</a>, choose the applicable specialty under the "Specialties" menu, then select the "Milestones" link in the lower navigation bar.

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.

Medical Knowledge 4: Assay Design and Verification/Validation (e.g., wet labs, troubleshooting)				
Level 1	Level 2	Level 3	Level 4	Level 5
Recognizes the requirements for validation and verification (FDA-approved) of molecular tests	With substantial guidance, designs assay, validation or verification experiments, and/or interpretation of the validation or verification data	With minimal guidance, designs assay, validation or verification experiments, and interpretation of the validation or verification data	Independently designs assay, validation or verification experiments, and interpretation of the validation or verification data	Leads/participates in expert guidelines for test validation
Recognizes the components of a validation or verification summary	Discusses and understand calculations for the components of a validation or verification summary	Drafts written validation or verification summary with guidance	Independently provides a written validation or verification summary	Is recognized as a content expert in validation design and data interpretation
		$\overline{\mathcal{A}}$		
Comments:			Not Yet ( Not Yet F	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 lir between levels indicates that miles in lower levels have been substant demonstrated as well as <b>some</b> milestones in the higher level(s).		tes that milestones been substantially I as <b>some</b>		

Patient Care 1: Quality Assurance and Quality Management					
Level 1	Level 2	Level 3	Level 4	Level 5	
Recognizes the importance of quality assurance and quality management	Understands the components of a comprehensive quality management plan	Actively participates in laboratory quality management and reviews data at designated intervals	Recommends improvements in laboratory activities to improve quality assurance metrics	Involved in local, regional, or national service in developing and/or implementing quality assurance programs and standards	
Comments:			Not Yet C Not Yet R	Completed Level 1	

Patient Care 2: Interpretation of Molecular and Genetic Testing				
Level 1	Level 2	Level 3	Level 4	Level 5
Identifies the elements required to interpret the results of molecular testing:  • Recognizes assayspecific quality assurance/quality control  • Discusses clinical indication of test  • Identifies elements of clinical report	With substantial guidance, interprets the results of molecular testing:  • Reviews/approves assay-specific quality assurance/quality control  • Correlates indication and test results  • Generates a clinical report	With minimal guidance, interprets the results of molecular testing:  • Identifies assay-specific quality assurance/quality control failures/issues  • Correlates indication and test results  • Generates a clinical report	Independently interprets the results of molecular testing:     Troubleshoots     assays     Correlates indication     and test results     Generates a clinical     report	Provides guidance and/or participates in setting policies or developing practice guidelines for reporting or interpretation of results including:  • Designing/implementing report template  • Trains more junior learners to interpret results of molecular testing
Comments:  Not Yet Completed Level 1 Not Yet Rotated				

Patient Care 3: Interdisciplinary Consultation				
Level 1	Level 2	Level 3	Level 4	Level 5
Identifies skills (verbal, written), techniques, and knowledge required to provide a consultation	Develops skills and knowledge to manage consultations	Manages consultations with assistance	Independently manages consultations	Is recognized as an expert in providing comprehensive consultations
Comments:  Not Yet Completed Level 1  Not Yet Rotated				

Medical Knowledge 1: Molecular Testing with Various Platforms (Diagnosis, Management, Prognostication)				
Level 1	Level 2	Level 3	Level 4	Level 5
Discusses basic principles and applications of various methodologies and testing platforms in the areas of:  • hematopathology • heritable diseases • identity/human leukocyte antigen (HLA) • infectious disease • pharmacogenomics • solid tumors	With substantial guidance, identifies best methods to use for diagnosis and disease-specific management	With minimal guidance, identifies best methods for diagnosis and disease-specific management	Independently identifies best methods for diagnosis and disease-specific management	Develops policies or practice guidelines to apply new techniques or new clinical correlations for testing procedures
Comments:  Not Yet Completed Level 1 Not Yet Rotated				

Medical Knowledge 2: Genomic Testing, Genomic Databases, and Bioinformatics				
Level 1	Level 2	Level 3	Level 4	Level 5
Explains differences between genetic and genomic analysis	With substantial guidance, identifies clinical situations in which genomic testing is appropriate	With minimal guidance, identifies clinical situations in which genomic testing is appropriate	Independently identifies clinical situations in which genomic testing is appropriate	Develops national or institutional polices or practice guidelines for genomic testing
Describes basic principles and methodology used for genomic analysis and the roles of bioinformatics and clinical genomic databases in genomic/molecular testing	Describes basic workflow of genomic analysis and bioinformatics in genomic/molecular testing and identifies information from clinical databases for final interpretation	With minimal guidance, interprets the information obtained from genomic testing, applies standard bioinformatics workflow and clinical databases for clinical interpretation, and address errors and artifacts	Independently interprets the information obtained from genomic testing, applies standard bioinformatics workflow and clinical databases for clinical interpretation, and troubleshoots genomic testing and bioinformatics pipeline	Develops and validates genomic tests, bioinformatics pipeline, and/or clinical genomic databases
Comments:  Not Yet Completed Level 1 Not Yet Rotated				

Medical Knowledge 3: Patient-Centered Interpretation				
Level 1	Level 2	Level 3	Level 4	Level 5
Understands the importance of ancillary data (e.g., medical history, family history, other diagnostic results) in the interpretation of molecular results	With substantial guidance, seeks and incorporates ancillary data (e.g., medical history, family history, other diagnostic results) in the interpretation of molecular results	With minimal guidance, seeks and incorporates ancillary data (e.g., medical history, family history, other diagnostic results) in the interpretation of molecular results	Independently seeks and incorporates ancillary data (e.g., medical history, family history, other diagnostic results) in the interpretation of molecular results	Develops algorithms and/or practice guidelines to incorporate ancillary data (e.g., medical history, family history, other diagnostic results) in the interpretation of molecular results
Comments:  Not Yet Completed Level 1 Not Yet Rotated				

Medical Knowledge 4: Assay Design and Verification/Validation (e.g., Wet Labs, Troubleshooting)				
Level 1	Level 2	Level 3	Level 4	Level 5
Recognizes the requirements for validation and verification (FDA-approved) of molecular tests	With substantial guidance, designs assay, validation or verification experiments, and/or interpretation of the validation or verification data	With minimal guidance, designs assay, validation or verification experiments, and interpretation of the validation or verification data	Independently designs assay, validation or verification experiments, and interpretation of the validation or verification data	Leads/participates in expert guidelines for test validation
Recognizes the components of a validation or verification summary	Discusses and understand calculations for the components of a validation or verification summary	Drafts written validation or verification summary with guidance	Independently provides a written validation or verification summary	Is recognized as a content expert in validation design and data interpretation
Comments:  Not Yet Completed Level 1  Not Yet Rotated				

Systems-Based Practice 1: Patient Safety and Quality Improvement (QI)				
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 clinicians and/or patients and their families, as appropriate (simulated or actual)	Discloses patient safety events to clinicians and/or patients and their families, as appropriate (simulated or actual)	Role models or mentors others in the disclosure of patient safety events
Demonstrates knowledge of basic QI methodologies and metrics	Describes departmental and institutional QI initiatives	Participates in departmental and institutional QI initiatives	Demonstrates the skills required to identify, develop, implement, and analyze a QI project	Creates, implements, and assesses QI initiatives at the institutional or community level
Comments:  Not Yet Completed Level 1				

Level 1	Level 2	Level 3	Level 4	Level 5
Demonstrates knowledge and importance of coordination in patient care	Coordinates care of patients in routine cases effectively among clinical and laboratory teams	Coordinates care of patients in complex cases effectively among clinical and laboratory teams	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
Explains key elements for safe and effective transitions of care and hand-offs	Performs safe and effective transitions of care/hand-offs in routine situations	Performs safe and effective transitions of care/hand-offs in complex situations	Models and advocates for safe and effective transitions of care/hand-offs within and across health care delivery systems	Designs improvement in quality of transitions of care within and across health care delivery systems to optimize patient outcomes

Systems-Based Practice 3: Community Health					
Level 1	Level 2	Level 3	Level 4	Level 5	
Demonstrates knowledge of population and community health needs and disparities	Identifies pathology's role in population and community health needs and inequities for the local population	Identifies opportunities for pathologists to participate in community and population health	Recommends and/or participates in changing and adapting practice to provide for the needs of communities and populations	Leads innovations and advocates for populations and communities with health care inequities	
Comments:  Not Yet Completed Level 1					

Systems-Based Practice 4: Physician Role in Health Care System				
Level 1	Level 2	Level 3	Level 4	Level 5
Identifies key components of the complex health care system (e.g., hospital, skilled nursing facility, 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., test utilization, turnaround time)	Manages various components of the complex health care system to provide efficient and effective patient care and transition of care	Advocates for or leads systems change that enhances high-value, efficient, and effective patient care and transition of care
Describes basic health payment systems (e.g., government, private, public, uninsured care) and practice models	Documents testing detail and explains the impact of documentation on billing and reimbursement	Engages with clinicians and/or patients in shared decision making, such as use of preauthorization for complex testing	Practices and advocates for cost-effective patient care with consideration of the limitations of each patient's payment model	Participates in health policy advocacy activities
Comments:  Not Yet Completed Level 1				

Level 1	Level 2	Level 3	Level 4	Level 5
Demonstrates knowledge that laboratories must be accredited and knowledge of the roles of different agencies	Demonstrates knowledge of the components of laboratory accreditation and regulatory compliance (Clinical Laboratory Improvement Amendments and others), either through training or experience	Identifies the differences between accreditation and regulatory compliance; discusses the processes for achieving accreditation and maintaining regulatory compliance	Participates in an internal laboratory inspection (actual or simulated)	Participates in an external laboratory inspection
Discusses the need for quality control and proficiency testing	With assistance, interprets quality data, charts, and trends, including proficiency testing results	Demonstrates knowledge of the components of a laboratory quality management plan, including submission and review of proficiency testing results and understanding the implications of testing failures	Participates in laboratory quality team:  • Drafts response to inspection deficiencies (actual or simulated)	Participates in laboratory quality team:  • Independently crafts response to inspection deficiencies or proficiency failures  • Reviews the quality management plan to identify areas for improvement

Systems-Based Practice 6: Utilization					
Level 1	Level 2	Level 3	Level 4	Level 5	
Identifies general molecular pathology work practices and workflow (e.g., nucleic acid extraction, polymerase chain reaction (PCR)-based testing)	Explains rationale for optimizing utilization, including batching and reflex algorithms	Identifies opportunities to optimize utilization of resources by reviewing reflex testing algorithms	Participates in a utilization review	Completes a utilization review and drafts change plan	
Recognizes outside resources for referred testing	Evaluates the need for referred testing	Participates in review of referral lab certification and appropriateness for referred testing	Helps to establish appropriate criteria for referred testing (i.e., correct gene/disorder)	Optimizes a test menu based on trends of referred testing	
Comments:  Not Yet Completed Level 1					

Practice-Based Learning and Improvement 1: Evidence-Based Practice and Scholarship						
Level 1	Level 2	Level 3	Level 4	Level 5		
Demonstrates how to access and select applicable evidence and use appropriate resources	Identifies and applies the best available evidence to guide diagnostic work-up of simple cases	Identifies and applies the best available evidence to guide diagnostic work-up of complex cases	Critically appraises and applies evidence to guide care, even in the face of conflicting data	Teaches others to critically appraise and apply evidence for complex cases; and/or leads/participates in the development of guidelines		
Comments:	Comments:  Not Yet Completed Level 1					

Level 1	Level 2	Level 3	Level 4	Level 5
Is aware of the need for patient privacy, autonomy, consent, and information safeguarding as applied to clinical and genetic research	Develops knowledge of the basic principles of research particularly as it pertains to genetic testing (demographics, Institutional Review Board, human subjects), including how research is evaluated, conducted, and applied to patient care	Applies knowledge of the basic principles of research, such as informed consent, and research protocols to clinical practice particularly as it pertains to genetic testing, with assistance	Proactively and consistently applies knowledge of the basic principles of research, such as informed consent and research protocols to clinical practice particularly as it pertains to genetic testing	Suggest improvements to research regulations and/or substantially contributes to the primary literature through basic, translational, or clinical research

Practice-Based Learning and Improvement 3: Reflective Practice and Commitment to Personal Growth					
Level 1	Level 2	Level 3	Level 4	Level 5	
Accepts responsibility for personal and professional development by establishing goals	Demonstrates openness to receiving performance data and feedback to inform goals	Seeks performance data and feedback with a receptive mindset	Actively and consistently seeks performance data and feedback with a receptive mindset	Models seeking performance data with a receptive mindset	
Identifies the gap(s) between expectations and actual performance	Analyzes and reflects on the factors that contribute to gap(s) between expectations and actual performance	Institutes behavioral change(s) to narrow the gap(s) between expectations and actual performance	Critically evaluates and continues to optimize the behavioral changes in narrowing the gap(s) between expectations and actual performance	Teaches others reflective practice	
Actively seeks help in designing a learning plan	With assistance, designs and implements a learning plan	Independently creates and implements a learning plan	Uses performance data to measure the effectiveness of the learning plan and improves it when necessary	Facilitates the design and implementation of learning plans for others	
Comments:	Comments:  Not Yet Completed Level 1				

Level 1	Level 2	Level 3	Level 4	Level 5
Demonstrates knowledge of the ethical principles underlying laboratory testing, including informed consent, confidentiality, error disclosure, stewardship of limited resources, equitable treatment of patient samples, and review of appropriateness of laboratory testing	Analyzes straightforward situations using ethical principles	Recognizes the need for and uses appropriate resources to seek guidance in managing and resolving complex ethical situations	Independently resolves and manages complex ethical situations	Identifies and seeks to address system-level factors that induce or exacerbate ethical problems or impede their resolution
Describes when and how to appropriately report professionalism lapses, including strategies for addressing common barriers; identifies and describes potential triggers for professionalism lapses	Demonstrates insight into professional behavior in routine situations; takes responsibility for understanding own personal role in professionalism lapses	Demonstrates professional behavior in complex or stressful situations	Recognizes situations that may trigger professionalism lapses and intervenes to prevent lapses in self and in others	Coaches others when their behavior fails to meet professional expectations

Professionalism 2: Accountability and Conscientiousness				
Level 1	Level 2	Level 3	Level 4	Level 5
Responds promptly to instructions, requests, or reminders to complete tasks and responsibilities	Takes appropriate ownership and performs tasks and responsibilities in a timely manner with attention to detail	Recognizes situations that may impact own ability to complete tasks and responsibilities in a timely manner and describes the impact on team	Anticipates and intervenes in situations that may impact others' ability to complete tasks and responsibilities in a timely manner	Designs and recommends new strategies to ensure that the needs of patients, teams, and systems are met
Understands the importance of well-defined workflow processes for laboratory efficacy and accurate patient reporting	Participates in monitoring laboratory operations and assists to resolve workflow issues	Prepares and leads troubleshooting efforts to correct workflow problems	Critically evaluates workflows and proposes recommendations to accomplish desired goals	Develops and implements process improvements across health care teams
Comments:			Not Yet (	Completed Level 1

Professionalism 3: Self-Awareness and Help-Seeking					
Level 1	Level 2	Level 3	Level 4	Level 5	
With assistance, recognizes limitations in the knowledge, skills, and behaviors of oneself or team	Independently recognizes limitations in the knowledge, skills, and behaviors of oneself or team and seeks help when needed	With assistance, proposes and implements a plan to remediate or improve the knowledge, skills, and behaviors of oneself or team	Independently develops and implements a plan to remediate or improve the knowledge, skills, and behaviors of oneself or team	Serves as a resource or consultant for developing a plan to remediate or improve the knowledge, skills, and behaviors	
With assistance, recognizes status of personal and professional well-being	Independently recognizes status of personal and professional well-being and seeks help when needed	With assistance, proposes and implements a plan to optimize personal and professional well-being	Independently develops and implements a plan to optimize personal and professional well- being	Coaches others when responses or limitations in knowledge/skills do not meet professional expectations	
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	
Uses language and non- verbal behavior to demonstrate respect and establish rapport	Establishes a relationship in straightforward encounters using active listening and clear language	Establishes a relationship in challenging patient encounters, as appropriate	Easily establishes relationships, with attention to patient/patient's family's concerns and context, regardless of complexity	Mentors others in situational awareness and critical self-reflection to consistently develop positive therapeutic relationships	
Identifies common barriers to effective communication (e.g., language, disability) while accurately communicating own role within the health care system	Identifies complex barriers to effective communication (e.g., health literacy, cultural differences)	When prompted, reflects on personal biases while attempting to minimize communication barriers	Independently recognizes personal biases while attempting to proactively minimize communication barriers	Models self-awareness while teaching a contextual approach to minimize communication barriers	
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	
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	Coordinates recommendations from different members of the health care team to optimize patient care	Models flexible communication strategies that value input from all health care team members, resolving conflict when needed	
Describes the utility of constructive feedback	Solicits feedback on performance as a member of the health care team	Integrates feedback from team members to improve communication	Communicates feedback and constructive criticism to superiors	Facilitates regular health care team-based feedback in complex situations	
Comments:  Not Yet Completed Level 1					

Interpersonal and Comm	nunication Skills 3: Commu	nication within Health Care	e Systems	
Level 1	Level 2	Level 3	Level 4	Level 5
Safeguards patient personal health information (PHI) by communicating through appropriate means as required by institutional policy (e.g., patient safety reports, cell phone/pager usage)	Appropriately selects forms of communication based on context and urgency of the situation	Communicates while ensuring security of PHI, with guidance	Independently communicates while ensuring security of PHI	Guides departmental or institutional communication around policies and procedures regarding the security of PHI
Identifies institutional and departmental structure for communication of issues	Respectfully communicates concerns about the system	Uses institutional structure to effectively communicate clear and constructive suggestions to improve the system	Initiates conversations on difficult subjects with appropriate stakeholders to improve the system	Facilitates dialogue regarding systems issues among larger community stakeholders (institution, health care system, field)
Comments:  Not Yet Completed Level 1				