Supplemental Guide:
Clinical Informatics

ACGME

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Milestones Supplemental Guide

This document provides additional guidance and examples for the Clinical Informatics Milestones. This is not designed to indicate any specific requirements for each level, but to provide insight into the thinking of the Milestone Work Group.

Included in this document is the intent of each Milestone and examples of what a Clinical Competency Committee (CCC) might expect to be observed/assessed at each level. Also included are suggested assessment models and tools for each subcompetency, references, and other useful information.

Review this guide with the CCC and faculty members. As the program develops a shared mental model of the Milestones, consider creating an individualized guide (Supplemental Guide Template available) with institution/program-specific examples, assessment tools used by the program, and curricular components.

Additional tools and references, including the Milestones Guidebook, Clinical Competency Committee Guidebook, and Milestones Guidebook for Residents and Fellows, are available on the Resources page of the Milestones section of the ACGME website.

Clinical Informatics Supplemental Guide

In 2009, the American Medical Informatics Association's (AMIA) development of the *Core Content for the Subspecialty of Clinical Informatics* was pivotal to the establishment of the clinical informatics subspecialty and accreditation of clinical informatics fellowship programs.[i,ii] The core content publication described clinical informatics practice in terms of four major domains and knowledge associated with each domain.

Since publication of the Core Content in 2009, clinical informatics specialty practice has evolved in response to:

- increased focus on using the data from electronic health records (EHRs) to support research, precision medicine, public health, and population health
- scientific advances such as phenomics that stimulated development and deployment of innovative data analytic methodologies
- expanded knowledge of how integrating health information technology into clinical processes impacts clinician productivity and patient satisfaction
- growing expectations among users (both clinicians and patients) for how they interact with computational resources.

Awareness of these changes prompted AMIA to consider how to update the Clinical Informatics Core Content to reflect current clinical informatics specialty practice. Additionally, as clinical informatics fellowship program directors gained experience in training and assessing fellows, it became clear that the knowledge outline in the clinical informatics specialty Core Content was not sufficient for developing competencies on which fellows could be both taught and assessed.[iii] To provide more specific guidance on competencies required for fellows, the clinical informatics specialty Core Content needed to expand to include tasks performed by clinical informatics specialty practitioners.

To address these issues, AMIA and the American Board of Preventive Medicine (ABPM) agreed to update and expand the clinical informatics specialty Core Content using a formal practice analysis methodology. In 2018, AMIA conducted this clinical informatics specialty practice analysis in collaboration with ABPM and with the support of the American Board of Pathology (ABPath). This practice analysis resulted in a validated, comprehensive, and contemporary Delineation of Practice comprising five domains, 42 tasks, and 139 knowledge and skill statements.[iv]

In September of 2018, the Community of Clinical Informatics Fellowship Directors (CIPD) Executive Council approved the formation of the [Clinical Informatics Fellowship] Criteria for Excellence Workgroup. This Workgroup was comprised of clinical informatics fellowship program directors and associate program directors and focused on the following aims:

1. Gather complete, accurate, and relevant Program Director for input into future ACGME Clinical Informatics Fellowship Program Requirement and Milestone revisions.
2. Build on the Clinical Informatics Subspecialty (CIS) Practice Analysis[v], particularly regarding delineating tasks and knowledge fellows should acquire during training.

The primary focus of this group and processes was the methodologically rigorous review and analysis of the clinical informatics specialty Delineation of Practice[4] resulting in a list of appropriately worded core tasks/subcompetencies for clinical informatics fellows to achieve. Knowledge statements were also included along with a map indicating which knowledge statements supported each task/subcompetency.

Building on the work of the Criteria for Excellence Workgroup, in 2021 the CIPD Curriculum Subcommittee initiated a rigorous process to 1) map each Delineation of Practice derived clinical informatics fellowship subcompetency onto one of the six ACGME Core Competencies and 2) develop clusters of Delineation of Practice-derived subcompetencies within each ACGME Core Competency for the purpose of composing Milestone grids for formative and summative assessments of clinical informatics fellows. These materials were provided to the ACGME Milestones Development group as the starting point for the revision of Clinical Informatics Milestones.

[1] Gardner RM, Overhage JM, Steen EB, et al. Core content for the subspecialty of clinical informatics. *J Am Med Inform Assoc* 2009;16:153-157.

[2] Safran C, Shabot MM, Munger BS, et al. Program requirements for fellowship education in the subspecialty of clinical informatics. *J Am Med Inform Assoc* 2009;16:158-166. Erratum in: *J Am Med Inform Assoc* 2009;16:605.

[3] Silverman HS, Lehmann CU, Munger BS. Milestones: critical elements in clinical informatics fellowship programs. *Appl Clin Inform* 2016;7:177-90.

[4] Silverman H, Steen EB, Carpenito JN, Ondrula CJ, Williamson JJ, Fridsma DB: Domains, tasks, and knowledge for clinical informatics subspecialty practice: results of a practice analysis, *Journal of the American Medical Informatics Association* April 30, 2019. https://doi.org/10.1093/jamia/ocz051.

Patient Care 1: Consumer Informatics Applications, Portals, and Telehealth **Overall Intent:** To develop, implement, evaluate and/or integrate portals and other consumer-facing health informatics applications (e.g., disease management, patient education, behavior modification); to participate in the design, evaluation, implementation, and/or support of telehealth and health information systems	
Milestones	**Examples**
Level 1 *Discusses the basis for a consumer-facing health informatics application* *Describes the key components and processes of telehealth, portals, and health information systems*	● Articulates the advantages, disadvantages, initial and ongoing costs, and drivers for a specific consumer-facing application within the organization ● Articulates infrastructure and processes necessary to allow telemedicine visits for primary care and specialty consultations
Level 2 *Identifies a use case for a consumer-facing health informatics application and deduces required functionalities* *Identifies a use case for telehealth, portals, and health information systems and describes workflow and functionalities*	● Identifies needs for a COVID-19 dashboard to inform consumers about local case rates, testing/vaccination sites, and other COVID-19-related information ● Identifies a specific telehealth use case within telepsychiatry
Level 3 *Applies tools for a consumer-facing health informatics application* *Evaluates applications for telehealth, portals, and health information systems*	● Accesses and describes current COVID-19-related consumer-facing health informatics applications ● Evaluates existing telepsychiatry use cases
Level 4 *Designs a consumer-facing health informatics application prototype* *Develops improvements to existing telehealth, portals, and health information system applications*	● Designs a COVID-19 dashboard to inform consumers about local case rates, testing/vaccination sites, and other COVID-19 information ● Improves and/or expands existing telepsychiatry capabilities
Level 5 *Implements or leads implementation of a consumer-facing health informatics application* *Designs and implements telehealth, portals, and health information systems*	● Implements, maintains, and improves a COVID-19 dashboard to inform consumers about local case rates, outcomes, testing/vaccination sites, and other COVID-19-related information ● Designs and implements new telepsychiatry systems and processes
Assessment Models or Tools	● Direct observation ● End-user evaluation

	● Multisource feedback ● Portfolio review of written project documentation of project process and results
Curriculum Mapping	●
Notes or Resources	● American Medical Association (AMA). Digital health implementation playbook series. https://www.ama-assn.org/practice-management/digital/digital-health-implementation-playbook-series-introduction ● American Telemedicine Association. https://www.americantelemed.org/ ● US Department of Health and Human Services. Getting started with telehealth. https://telehealth.hhs.gov/providers/getting-started/ ● Johnson K, Jimison HB, Mandl KD. Consumer health informatics and personal health records. In *Biomedical Informatics.* London: Springer; 2014:517-539. ● Starren JB, Nesbitt TS, Chiang MF. Telehealth. In *Biomedical Informatics*. London: Springer; 2014: 541-560. ● Wilson A, Lehmann C, Saleh S, Hanna J, Medford R. Social media: A new tool for outbreak surveillance. *Antimicrobial Stewardship & Healthcare Epidemiology* 2021;1(1),E50. doi:10.1017/ash.2021.225.

Patient Care 2: Emerging Data Sources **Overall Intent:** To access and incorporate information from emerging data sources (e.g., imaging, bioinformatics, internet of things, patient-generated, social determinants); to assess and prioritize the integration of data from medical devices (e.g., pumps, telemetry monitors, consumer devices) into information systems	
Milestones	**Examples**
Level 1 *Describes opportunities and challenges to the acquisition and use of emerging data sources* *Describes medical device data formats, types, and architecture*	● Describes the challenges of importing data from various emerging data sources such as glucose monitors to the EHR for decision support and medical decision making ● Describes what the data look like that are derived from a glucose monitor ● Lists the data types that include HgbA1c, blood glucose, and insulin dosing, etc.
Level 2 *Creates a plan to analyze and develop knowledge from emerging data sources* *Defines and electronically accesses medical device data*	● Identifies use cases to incorporate data from emerging sources such as continuous glucose monitors ● Outlines a project that includes data from personal devices such as smart watch and assess the feasibility
Level 3 *Analyzes and develops knowledge from emerging data sources* *Extracts, stores, and analyzes data from medical devices*	● Combines longitudinal glucose monitoring with HgA1c data for analysis of control of diabetes; summarizes on cohort and patient levels in a dashboard ● Analyzes data from telemetry alarms to aid in identifying error rates ● Applies informatics methods in the analysis of longitudinal medical device data, such as data from intravenous (IV) pumps, intensive care unit (ICU) monitors, and ventilators
Level 4 *Implements specialty-specific systems to access and incorporate emerging data sources into the electronic health record (EHR)* *Assesses and prioritizes the integration of data from medical devices*	● Works with a project team to implement an application programming interface (API) or other interface to import patient-generated data from diabetes management apps into the EHR ● Uses data from IV pumps, ICU monitors, and ventilators to improve early warning systems
Level 5 *Accesses and incorporates information from emerging data sources* *Develops improvements to integration and use of medical device data*	● Uses commercially available tools to develop a mobile device-based app to deliver patient derived data to a provider for analysis ● Works on a project to use artificial intelligence (AI) to analyze echocardiogram data to predict outcomes
Assessment Models or Tools	● Direct observation ● End-user evaluation ● Multisource feedback ● Portfolio review of written project documentation of project process and results

Curriculum Mapping	●
Notes or Resources	● Baig MM, GholamHosseini H, Gutierrez J, Ullah E, Lindén M. Early detection of prediabetes and T2DM using wearable sensors and internet-of-things-based monitoring applications. *Applied Clinical Informatics*. 2021;12(1):001-9. ● Galindo RJ, Umpierrez GE, Rushakoff RJ, et al. Continuous glucose monitors and automated insulin dosing systems in the hospital consensus guideline. *J Diabetes Sci Technol*. 2020;14(6):1035-1064. doi: 10.1177/1932296820954163. Epub September 28, 2020. PMID: 32985262; PMCID: PMC7645140. ● IEEE. Pre-standards workstream report: Clinical IoT [internet of things] data validation and interoperability with blockchain. In *Pre-Standards Workstream Report: Clinical IoT Data Validation and Interoperability with Blockchain* Published June 28, 2019. 1-29. https://ieeexplore.ieee.org/servlet/opac?punumber=8764086 ● IEEE Internet of Things Journal. https://ieee-iotj.org ● O'Leary CP, Matthew A. Emerging opportunities to harness real world data: An introduction to data sources, concepts, and applications. *Diabetes, Obesity and Metabolism.* 2020, 22(S3):3-12. https://doi.org/10.1111/dom.13948.

Medical Knowledge 1: Project Management **Overall Intent:** To leverage the processes and principles of project management to facilitate the successful completion of projects	
Milestones	**Examples**
Level 1 *Describes basic project management principles and identifies resources and tools for projects*	● Identifies Gantt charts as a project management tools
Plans and develops a project idea	● Participates in brainstorming for possible solutions in patient safety projects, including decision support ● Explores and reports on situations and conditions that may be dangerous for patient care, such as the use of imperial and metric weight recording
Level 2 *Identifies suitable areas to apply project management tools*	● Identifies the part of the project for which a Gantt chart is appropriate
Creates and leads a team	● Identifies subject matter experts in clinical decision support to build the team
Level 3 *Designs a project, leveraging project management principles*	● Puts together a project charter
Sets deadlines and monitors project progress according to the project plan	● Monitors clinical decision support project progress and sets appropriate deadlines ● Monitors to ensure deadlines are met
Level 4 *Implements a project using project management principles*	● Implements clinical decision support project using appropriate project management tools, according to Gantt chart timeline ● Is familiar with locally used project management tools (e.g., Jira)
Addresses and solves problems	● Identifies risks, potential points of failure, and critical path for clinical decision support project
Level 5 *Manages a project from initiation to completion, including scope, resources, and timeline*	● Manages a clinical decision support project team from needs assessment to evaluation, including budget development
Successfully manages customer expectations and evaluates projects	● Manages clinical sponsors' expectations and develops solutions that align with customers' needs
Assessment Models or Tools	● Direct observation ● End-user evaluation ● Multisource feedback ● Portfolio review of written project documentation of project process and results

Curriculum Mapping	●
Notes or Resources	● Microsoft Project for GANTT charts ● Project Management Institute. *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*. Newton Square, PA: Project Management Institute; 2001. ● Project Management Institute. *A Guide to the Project Management Body of Knowledge (PMBOK® Guide).* 6th ed. Newton Square, PA: Project Management Institute; 2017. https://www.pmi.org/pmbok-guide-standards/foundational/pmbok ● Verzuh, E. *The Fast Forward MBA in Project Management*. 5th ed. Wiley; 2016.

Medical Knowledge 2: Implementations/Health Information Technology (HIT) Knowledge **Overall Intent:** To plan and/or participate in HIT implementations and upgrades; to implement, integrate, monitor, evaluate, and maintain EHR and/or applied HIT systems, in collaboration with information technology (IT) staff, based on clinical expertise and best practice to support optimum clinical workflow	
Milestones	**Examples**
Level 1 *Discusses the features and functionalities of EHRs and other clinical information systems* *Possesses basic knowledge of HIT systems and their integration into the enterprise* *Demonstrates basic knowledge of HIT industry standards and ontologies*	● Describes EHR functional model ● Describes features of provider order entry ● Discusses workflow of Laboratory Information Systems data in the enterprise ● Describes SNOMED Clinical Terms (SNOWMED CT), LOINC, and RxNorm ontologies ● Familiar with definition and functionality of Digital Imaging and Communications in Medicine (DICOM), Fast Healthcare Interoperability Resources (FHIR), and Health Level Seven International (HL7) standards
Level 2 *Conducts requirement specifications* *Defines best practices for EHR implementation and maintenance* *Identifies and maintains stakeholder expectations*	● Develops requirement specifications for new antibiotic orders in provider order entry ● Defines best practices such as weight-based prescribing, where needed and looks for allergies, drug-drug interactions, and other drug-disease contraindications to prescribing new antibiotics ● Manages to achieve an alert volume that is acceptable to end users and avoids alert fatigue ● Communicates with clinical end-users regarding new feature expectation, and explains why a feature is or is not included in the next EHR update
Level 3 *Participates in the system selection process using shared principles for the selection* *Collaborates with members of an interprofessional clinical informatics team to implement, integrate, monitor, or evaluate the EHR or other clinical information systems* *Designs and implements solutions*	● Evaluates existing decision support systems from a vendor ● Serves on the implementation team for a new clinical decision support system, such as physician order entry ● Designs and implements a new antibiotic order set with embedded clinical decision support (CDS) ● Is included as member of product selection committee ● Interviews stakeholders in clinical departments to identify needs

Level 4 *Participates in leadership of the project group* *Demonstrates leadership skills during implementation projects* *Evaluates projects and provides solutions*	● Serves as the lead for a specific aspect of the design and implementation of the order set for clinical decision support ● Meaningfully participates in LEAN/Six Sigma project ● Demonstrates ability to reach out to constituencies for information and feedback ● Runs an effective meeting; creates an agenda, facilitates discussion, builds consensus leading to decisions, and generates actionable documentation ● Evaluates a new order set for collision and consistency with other order sets as well as for risk for duplicate ordering
Level 5 *Leads project groups in the design, implementation, and upgrade of EHRs and other clinical information systems* *Leads the evaluation a of clinical informatics project related to EHRs and other clinical information systems* *Provides knowledge management to existing solutions*	● Evaluates success factors of an EHR upgrade or other clinical informatics project ● Acts as subject matter expert to describe EHR solutions to issues raised by clinical departments/stakeholders ● Creates a systematic method using existing clinical decision support performance information to improve ability to meet evolving guidelines
Assessment Models or Tools	● Direct observation ● End-user evaluation ● Multisource feedback ● Portfolio review of written project documentation of project process and results
Curriculum Mapping	●
Notes or Resources	● McEvoy DS, Sittig DF, Hickman TT, et al. Variation in high-priority drug-drug interaction alerts across institutions and electronic health records. *J Am Med Inform Assoc*. 2017;24(2):331-338. doi: 10.1093/jamia/ocw114. PMID: 27570216; PMCID: PMC5391726. ● Office of the National Coordinator for Health Information Technology. HealthIT.gov Implementation Resources.https://healthit.gov/healthit-resources/implementation-resources.

Systems-Based Practice 1: Health Information Technology (HIT) Knowledge of Testing, Implementation, and Monitoring **Overall Intent:** To maintain awareness of health care and IT landscapes including available products, innovation strategies, emerging technologies, and legal and regulatory requirements to design technical solutions to enterprise challenges	
Milestones	**Examples**
Level 1 *Describes the significance of legal and regulatory issues related to technical solutions to enterprise challenges* *Discusses the role of vendor HIT products, emerging technologies, and innovation*	● Articulates legal and regulatory issues for the use of remote access to laboratory, pathology, radiology, and other EHR data by primary care physician offices ● Discusses specific methods for screening vendor solicitations related to HIT products and emerging technologies ● Reviews the process of innovation and the advantages and disadvantages of innovation on an enterprise level
Level 2 *Identifies key factors associated with legal and regulatory issues related to technical solutions to enterprise challenges* *Identifies opportunities for the use of vendor HIT products, emerging technologies, and innovation*	● Determines and prioritizes factors related to legal and regulatory issues regarding remote access to laboratory, pathology, radiology, and other EHR data by primary care physician offices ● Creates an inventory of vendor products for a specific use case involving emerging technologies and innovation focused on secure and efficient health care team communication
Level 3 *Participates in identifying legal and regulatory issues related to technical solutions to enterprise challenges* *Analyzes HIT products, emerging technologies, and innovation for one or more specific opportunities*	● Identifies legal and regulatory issues related to providing remote access to laboratory, pathology, radiology, and other EHR data by primary care physician offices ● Analyzes efficacy and usability of HIT products, emerging technologies, and innovation focused on the inclusion and use of social determinants to improve the health of individuals and populations
Level 4 *Addresses legal and regulatory issues related to technical solutions to enterprise challenges and assures compliance with regulations* *Participates meaningfully in selection and implementation of HIT products, emerging technologies, and innovation*	● Effectively implements, monitors, and improves solutions to legal and regulatory issues related to providing remote access to laboratory, pathology, radiology, and other EHR data to primary care physician offices ● Uses usability methodology to evaluate functionality of HIT products ● Participates in and meaningfully contributes to the implementation of innovative approaches to gathering and using social determinants of health to improve the health of individuals and populations

Level 5 *Leads processes addressing legal and regulatory issues related to technical solutions to enterprise challenges* *Leads projects related to the implementation of HIT products, emerging technologies, and innovation*	● Develops, leads, monitors, and continuously improves the outcomes of processes which improve remote access to laboratory, pathology, radiology, and other EHR data for primary care physician offices ● Develops, leads, monitors, and continuously improves innovative approaches to gathering and using social determinants of health to improve the health of individuals and population health management
Assessment Models or Tools	● Direct observation ● End-user evaluation ● Portfolio review of written project documentation of project process and results ● Multisource feedback
Curriculum Mapping	●
Notes or Resources	● Office of the National Coordinator for Health Information Technology. HealthIT.gov Implementation Resources. https://www.healthit.gov/healthit-resources/implementation-resources. ● Office of the National Coordinator for Health Information Technology. HealthIT.gov Laws, Regulation, and Policy. https://www.healthit.gov/topic/laws-regulation-and-policy. ● Office of the National Coordinator for Health Information Technology. HealthIT.gov Playbook https://www.healthit.gov/playbook/.

Systems-Based Practice 2: Standards and Interoperability **Overall Intent:** To apply methods and standards for data sharing across systems to support data sharing through health information exchanges, public health reporting, or other mechanisms; to reconcile requirements for clinical integration of data with technical constraints to maintain connectivity, interfacing, and validity of content between systems and clinical areas; to advance/foster interoperability between disparate health information systems	
Milestones	**Examples**
Level 1 *Describes methods and standards for data sharing across systems to support data sharing through health information exchanges, public health reporting, or other mechanisms*	● Reviews key issues, methods, and standards related to data normalization and sharing related to implementation of required reporting of sexually transmitted diseases to governmental agencies
Discusses issues related to ensuring connectivity, interfacing, and validity of content between systems and clinical areas	● Discusses issues related to normalizing laboratory reference ranges between systems when reporting laboratory results
Discusses sociocultural and other issues regarding fostering interoperability between disparate health information systems	● Reviews sociocultural issues related to the integration of data originating in laboratory, radiology, and pharmacy systems to support enhanced CDS
Level 2 *Analyzes key factors regarding methods and standards for data sharing across systems to support data sharing through health information exchanges, public health reporting, or other mechanisms*	● Identifies and analyzes key factors regarding methods and standards for the reporting of sexually transmitted diseases to governmental agencies
Identifies requirements and/or constraints related to ensuring connectivity, interfacing, and validity of content between systems and clinical areas	● Effectively identifies requirements and/or constraints to normalizing laboratory reference ranges between systems when reporting laboratory results
Analyzes key factors in fostering interoperability between disparate health information systems	● Analyzes key factors and challenges to meaningful integration of data originating in laboratory, radiology, and pharmacy systems to support enhanced CDS
Level 3 *Identifies opportunities for data sharing across systems to support data sharing through health information exchanges, public health reporting, or other mechanisms*	● Identifies legal and regulatory issues related to implementation of required reporting of sexually transmitted diseases to governmental agencies

Participates in efforts to ensure connectivity, interfacing, and validity of content between systems and clinical areas *Identifies opportunities to foster interoperability between disparate health information systems*	● Contributes meaningfully to normalizing laboratory reference ranges between systems when reporting laboratory results ● Identifies opportunities to meaningfully integrate data originating in laboratory, radiology, and pharmacy systems to support enhanced CDS
Level 4 *Participates in efforts to design and implement methods and standards for data sharing across systems to support data sharing through health information exchanges, public health reporting, or other mechanisms* *Develops solutions to ensure connectivity, interfacing, and validity of content between systems and clinical areas* *Participates meaningfully in efforts to foster interoperability between disparate health information systems*	● Participates effectively in implementing, monitoring, and improving solutions to legal and regulatory issues related to required reporting of sexually transmitted diseases to governmental agencies ● Develops solutions to normalize laboratory reference ranges between systems when reporting laboratory results ● Develops a solution which effectively incorporates and integrates data originating in laboratory, radiology, and pharmacy systems to support enhanced CDS ● Implements LOINC codes for the laboratory test result names
Level 5 *Leads efforts to design and implement methods and standards for data sharing across systems to support data sharing through health information exchanges, public health reporting, or other mechanisms* *Implements solutions to ensure connectivity, interfacing, and validity of content between systems and clinical areas* *Leads efforts to foster interoperability between disparate health information systems*	● Develops, leads, monitors, and continuously improves the outcomes of processes that improve required reporting of sexually transmitted diseases to governmental agencies ● Implements solutions to normalize laboratory reference ranges between systems when reporting laboratory results ● Leads teams which develop, monitor, and continuously improve processes and systems effectively and continuously incorporates and integrates data originating in laboratory, radiology, and pharmacy systems to support enhanced CDS
Assessment Models or Tools	● Direct observation ● End-user evaluation ● Multisource feedback ● Portfolio review of written project documentation of project process and results
Curriculum Mapping	●

Notes or Resources	● HL7 FHIR. https://hl7.org/fhir/overview.html. ● Office of the National Coordinator for Health Information Technology. HealthIT.gov Health IT and Health Information Exchange Basics. https://www.healthit.gov/topic/health-it-and-health-information-exchange-basics/what-hie. ● Shapiro JS, Mostashari F, Hripcsak G, Soulakis N, Kuperman G. Using health information exchange to improve public health. *Am J Public Health*. 2011 Apr;101(4):616-23. doi: 10.2105/AJPH.2008.158980. Epub February 17, 2011. PMID: 21330598; PMCID: PMC3052326.

Systems-Based Practice 3: Data Integrity/Security **Overall Intent:** To develop, implement, and/or leverage data life cycle processes for defining sources, and acquiring, storing, cleaning, and ensuring integrity of data to safeguard the availability of relevant and valid data to meet clinical, quality, research, business, and strategic objectives; to participate in ongoing security threat assessments, development of clinician facing and enterprise security policy, and reinforce security training and policies with clinical staff members	
Milestones	**Examples**
Level 1 *Discusses data issues and processes to safeguard the availability of relevant and valid data to meet clinical, quality, research, business, and strategic objectives* *Describes security threat assessments, development of security policies, and training*	● Discusses issues related to data life cycle for transactional and reporting/research databases ● Discusses local, national, and/or international security standards and safeguards and security threat assessment methods and mitigation strategies related to phishing and deep fakes
Level 2 *Analyzes key factors in existing efforts to safeguard the availability of relevant and valid data to meet clinical, quality, research, business, and strategic objectives* *Recognizes key factors and benefits related to security threat assessments, development of security policies, and training*	● Analyzes key factors related to existing data life cycle for transactional and reporting/research databases ● Identifies key factors and benefits related to security standards and safeguards and security threat assessment methods and mitigation strategies related to phishing and deep fakes
Level 3 *Identifies opportunities for implementing new processes to safeguard the availability of relevant and valid data to meet clinical, quality, research, business, and strategic objectives* *Identifies areas of focus for security threat assessments, development of security policies, and training*	● Identifies key opportunities for implementing new processes to safeguard transactional and reporting/research databases to meet clinical, quality, research, business, and strategic objectives ● Identifies areas of focus for security threat assessment methods and mitigation strategies related to medical devices such as infusion pumps including the development of security policies and training
Level 4 *Meaningfully participates in the development of new processes to safeguard the availability of relevant and valid data to meet clinical, quality, research, business, and strategic objectives*	● Meaningfully participates in the development of new processes to safeguard the availability of relevant and valid transactional and reporting/research databases to meet clinical, quality, research, business, and strategic objectives

Meaningfully engages in efforts to conduct security threat assessments, development of security policies, and training	● Engages in conducting security threat assessment methods and mitigation strategies related to medical devices such as infusion pumps
Level 5 *Leads efforts to implement processes to safeguard the availability of relevant and valid data to meet clinical, quality, research, business, and strategic objectives* *Educates others regarding security threat assessments, development of security policies, and training*	● Leads efforts to safeguard the availability of relevant and valid transactional and reporting/research databases to meet clinical, quality, research, business, and strategic objectives ● Educates others regarding establishing, monitoring, and improving processes and outcomes related to security threat assessments and the development of security policies, and training
Assessment Models or Tools	● Direct observation ● End-user evaluation ● Portfolio review of written project documentation of project process and results ● Multisource feedback
Curriculum Mapping	●
Notes or Resources	● Healthcare Information and Management Systems Society, Inc. (HIMSS). Cybersecurity in Healthcare Guide. https://www.himss.org/resources/cybersecurity-healthcare. ● Lehmann CU, Kim GR, Gujral R, Veltri MA, Clark JS, Miller MR. Decreasing errors in pediatric continuous intravenous infusions. *Pediatr Crit Care Med*. 2006 May;7(3):225-30. doi: 10.1097/01.PCC.0000216415.12120.FF. PMID: 16575355.

Practice-Based Learning and Improvement 1: Optimization, Downtime, Functional Requirements **Overall Intent:** To analyze and identify necessary system and process changes to optimize clinical and related workflows	
Milestones	**Examples**
Level 1 *Discusses challenges associated with clinical information system upgrades and downtime* *Articulates functional requirements related to EHR optimization and system downtime*	● Assesses pre-existing clinical information systems and finds pain points from different perspectives ● Documents or maps out potential upstream/downstream effects to pain points ● Meets with stakeholders and drafts functional requirements for upgrades ● Articulates sociotechnical challenges with proposed changes/solutions ● Maps workflows in clinical departments to downtime EHR use protocols
Level 2 *Provides direct user support during EHR upgrades, routine system maintenance cycles, and downtime* *Supports clinicians in EHR optimization and system downtime*	● Learns and teaches users about upcoming upgrades and downtime procedures ● Curates curriculum for training to fit end-user's schedules and roles ● Troubleshoots or escalates problems appropriately during upgrades/downtime ● Identifies key figures in organization to ensure a successful EHR upgrade/downtime
Level 3 *Analyzes workflows related to clinician use of the EHR and suggests techniques for optimization of both workflows and EHR use* *Analyzes downtime events and identifies areas for improvement*	● Analyzes and optimizes personal workflows ● Creates and delivers at-the-elbow training for clinician to optimize EHR use ● Teaches an EHR training session for clinical end-users
Level 4 *Develops and deploys specific system and process changes during EHR upgrades and for optimization-related clinical informatics projects* *Develops solution for downtime problems and challenges*	● Identifies and assembles key team members for a core EHR training team ● Provides written/audio/audiovisual reference material of upcoming changes to be disseminated in organization ● Creates, evaluates, and modifies the project implementation timeline ● Evaluates whether there is adequate support to ensure timeline to implementation is adhered to ● Implements a reporting and feedback mechanism for users during upgrades/downtime
Level 5 *Develops and executes EHR upgrade, optimization, and downtime procedures*	● Creates a downtime plan for clinical unit in the hospital
Assessment Models or Tools	● Direct observation ● End-user evaluation ● Simulation

Curriculum Mapping	●
Notes or Resources	● HIPAA [Health Insurance Portability and Accountability Act] Journal. Optimizing Clinical Workflows. https://www.hipaajournal.com/optimizing-clinical-workflows-in-healthcare/. ● Pirtle CJ, Reeder RR, Lehmann CU, Unertl KM, Lorenzi NM. Physician perspectives on training for an EHR implementation. *Stud Health Technol Inform*. 2019;264:1318-1322. doi: 10.3233/SHTI190440. PMID: 31438139.

Practice-Based Learning and Improvement 2: Clinical Decision Support (CDS) **Overall Intent:** To develop, implement, evaluate, monitor, and /or maintain clinical decision support.	
Milestones	**Examples**
Level 1 *Identifies the elements and categories and discusses the challenges of CDS, such as alert fatigue*	● Gives examples where a CDS System cause alert fatigue, e.g., medication management to avoid acute kidney injury, non-steroidal anti-inflammatory drug (NSAID) use in arthritis patients receiving methotrexate
Level 2 *Describes the basics of the science of decision-making, including heuristics and tools to analyze decisions*	● Identifies techniques to overcome specific cognitive biases that result in considering incomplete information when making clinical decisions, e.g., not considering allergies when starting a new antibiotic
Level 3 *Participates in the design and evaluation of an evidence-based CDS based on input from stakeholders*	● As part of a committee, designs a CDS alert for supplementing potassium before administering a loop diuretic if the potassium is low ● Works in a team to implement CDS for radiology appropriate use criteria for the Protecting Access to Medicare Act (PAMA)
Level 4 *Assists in implementation of an evidence-based CDS, and monitors its effectiveness using key outcomes/measures/metrics*	● Uses a run chart used during PDSA (Plan-Do-Study-Act) cycles to monitor the number of alerts fired over time, and actions taken
Level 5 *Leads the design and implementation of an evidence-based CDS and develops a plan to identify and monitor key outcomes/measures/metrics*	● Designs and implements a CDS system for drug safety monitoring for cyclophosphamide-induced leukopenia by identifying the key metric as the white blood cell count lab value 10 days post-drug initiation ● Monitors the effectiveness of this alert with reports (including potential savings per alert)
Assessment Models or Tools	● Direct observation ● End-user evaluation ● Simulation
Curriculum Mapping	●
Notes or Resources	● Ash JS, Sittig DF, Guappone KP. et al. Recommended practices for computerized clinical decision support and knowledge management in community settings: a qualitative study. *BMC Med Inform Decis Mak* 2012;12(6). https://doi.org/10.1186/1472-6947-12-6 ● Bates DW, Kuperman GJ, Wang S et al. Ten commandments for effective clinical decision support: making the practice of evidence-based medicine a reality. *J Am Med Inform Assoc.* 2003;10(6):523-30. doi: 10.1197/jamia.M1370. Epub August 4, 2003. PMID: 12925543; PMCID: PMC264429. ● Hendrickson CD, McLemore MF, Dahir KM, et al. Is the climb worth the view? The savings/alert ratio for reducing Vitamin D testing. *Appl Clin Inform.* 2020;11(1):160-165.

	doi: 10.1055/s-0040-1701678. Epub February 26, 2020. PMID: 32102108; PMCID: PMC7043952. ● McGreevey III JD, Mallozzi CP, Perkins RM, Shelov E, Schreiber R. Reducing alert burden in electronic health records: state of the art recommendations from four health systems. *Appl Clin Inform.* 2020;11(1):1-12. doi: 10.1055/s-0039-3402715. Epub January 1, 2020. PMID: 31893559; PMCID: PMC6938713.

Practice-Based Learning and Improvement 3: Analytics **Overall Intent:** To employ data mining and analytic techniques (data visualization, artificial intelligence, natural language processing, machine learning) to optimize clinical and business decision making; to identify, execute, interpret, and disseminate measures and/or predictive analytics to provide actionable feedback to improve individual and organizational performance	
Milestones	**Examples**
Level 1 *Discusses various data mining and analytics techniques*	• Identifies publicly available state Department of Health (DOH) data on COVID-19 and chooses the appropriate analytics tool to explore the data and develop new knowledge
Level 2 *Identifies appropriate data analytics tools and visualizations for a specific use case*	• Summarizes statistics regarding the state DOH and demographics of COVID-19 patients at the fellow's institution • Identifies the appropriate analytics tool to extract state DOH information about patients with COVID-19 at the fellow's institution • Describes visualization formats that would best present the data
Level 3 *Constructs queries using database query languages and ancillary software and performs preliminary analysis on datasets*	• Constructs a query to extract smoking history for all COVID-19 patients who required ICU admission • Presents results of data queries of publicly available datasets using SQL query language
Level 4 *Analyzes datasets using programming tools and present summary findings to stakeholders using data visualization tools*	• Uses programming languages R, Python, SQL, and/or others to summarize characteristics of a patient population with COVID-19 • Presents results of the query as visualizations in fourth-generation language tools, including Tableau
Level 5 *Leverages analytics to improve patient care*	• Uses results of data analytics as basis for CDS tools • Constructs a query to identify patients with COVID-19 with state DOH risk factors and connects them to case management resources • Troubleshoots query language and guide colleagues
Assessment Models or Tools	• Program execution in practice environment • Direct observation • End-user evaluation • Simulation
Curriculum Mapping	•
Notes or Resources	• Davenport TH and Davenport JH. *Competing on Analytics: The New Science of Winning.* Boston, MA: Harvard Business School Press; 2017. ISBN: 9781422103326 • Hersh W. *Information Retrieval: A Health and Biomedical Perspective*. 4th ed. Switzerland: Springer Nature; 2020. • Kachchi V and Kothiya Y. 4 types of data analytics every analyst should know-descriptive, diagnostic, predictive, prescriptive. Medium.com. Published May 8, 2021. https://medium.com/co-learning-lounge/types-of-data-analytics-descriptive-diagnostic-predictive-prescriptive-922654ce8f8f.

	● Kuhn M and Johnson K. *Applied Predictive Modeling.* New York, NY: Springer; 2013. ISBN: 978-1461468486. ● Velasco F, Yang DM, Zhang M, et al. *Association of Healthcare Access with intensive care unit utilization and mortality in patients of Hispanic ethnicity hospitalized with COVID-19*. *J Hosp Med.* 2021;16(11):659-666. https://doi.org/10.12788/jhm.3717. PMID: 34730508; PMCID: PMC8577697. ● World Health Organization. The Global Health Observatory. https://www.who.int/data/gho/data/

Practice-Based Learning and Improvement 4: Human-Computer Interaction (HCI) and User Interfaces (UI) **Overall Intent:** To assess/evaluate and/or improve usability of user-facing technology for clinicians	
Milestones	**Examples**
Level 1 *Identifies models, theories, and practices of HCI, including interface design standards and principles*	● Identifies properties of HCI and UI reflected by Hickman law, keystroke-level model, and Fitt's law
Level 2 *Discusses the role of EHR UI in causing clinical errors*	● Communicates an example of how a specific EHR UI can lead to or prevent clinical errors, such as display of patient weight in nonstandard units leading to an antibiotic dosing error ● Participates in a root cause analysis to evaluate the role of the EHR in a reported safety event
Level 3 *Participates in analysis of feedback of EHR users of UI as new functionalities or modules are implemented*	● Attends meetings of EHR users providing feedback to periodic upgrades in functionalities, such as UI changes in viewing scheduling, entering documentation, and using order sets
Level 4 *Evaluates elements of usability of a new EHR module or functionality*	● Uses the three major categories of usability evaluation (testing, inspection, and inquiry)
Level 5 *Designs or modifies a prototype for UI that can be used by clinical end users*	● Designs a wireframe or similar model prototype of a UI that can be used to design an app on a mobile platform ● Creates a plan to resolve a user interface issue
Assessment Models or Tools	● Direct observation ● End-user evaluation ● Simulation
Curriculum Mapping	●
Notes or Resources	● Lowry S, Quinn M, Ramaiah, M et al. Technical evaluation, testing and validation of the usability of electronic health records. Published online. National Institute of Standards and Technology (NIST). February 2012. Accessed November 23, 2021. https://doi.org/10.6028/NIST.IR.7804 ● User Experience Professionals' Association. GOMS [Goals, Operators, Methods, and Selection]. Usability Body of Knowledge website. www.usabilitybok.org/goms ● MacKenzie, IS. Motor behaviour models for human-computer interaction. In Carroll JM, ed. *HCI models, theories, and frameworks: Toward a Multidisciplinary Science.* San Francisco: Morgan Kaufmann; 2003:27-54. ● Nielsen J. 10 Usability heuristics for user interface design. Nielsen Norman Group website. Published April 24, 1994. Updated November 15, 2020. https://www.nngroup.com/articles/ten-usability-heuristics/

	● National Aeronautics and Space Administration (NASA). NASA TLX: Task Load Index. Web page. Updated December 15, 2020. https://humansystems.arc.nasa.gov/groups/TLX/ ● Agency for Healthcare Research and Quality (AHRQ). NASA task load index. Digital Healthcare Research website. https://digital.ahrq.gov/health-it-tools-and-resources/evaluation-resources/workflow-assessment-health-it-toolkit/all-workflow-tools/nasa-task-load-index ● US General Services Administration. Prototyping. Usability.gov website. https://www.usability.gov/how-to-and-tools/methods/prototyping.html ● Zhang J and Walji M. Better EHR: usability, workflow and cognitive support in electronic health records. Website document. UT [University of Texas Health] National Center for Cognitive Informatics and Decision Making in Healthcare. Published November 2014. https://sbmi.uth.edu/nccd/better-ehr/BetterEHR.pdf

Practice-Based Learning and Improvement 5: Reflective Practice and Commitment to Personal Growth **Overall Intent:** To seek clinical performance information with the intent to improve care; reflects on all domains of practice, personal interactions, and behaviors, and their impact on colleagues and patients (reflective mindfulness); develop clear objectives and goals for improvement in some form of a learning plan	
Milestones	**Examples**
Level 1 *Accepts responsibility for personal and professional development by establishing goals* *Identifies the factors that contribute to gap(s) between expectations and actual performance* *Actively seeks opportunities to improve*	● Sets a personal practice goal of documenting use of the fishbone diagrams for quality improvement ● Identifies gaps in knowledge of root cause analysis ● Asks for feedback from patient care and HIT team members
Level 2 *Demonstrates openness to performance data (feedback and other input) to inform goals* *Analyzes and reflects on the factors that contribute to gap(s) between expectations and actual performance* *Designs and implements a learning plan, with prompting*	● Integrates feedback to adjust the documentation of the fishbone diagrams for quality improvement program (new PDSA cycle) ● Assesses time management skills and how it impacts timely completion of root cause analysis and failure mode and effect analysis ● When prompted, develops individual education plan to improve the evaluation of quality improvement methods
Level 3 *Seeks performance data episodically, with adaptability and humility* *Analyzes, reflects on, and institutes behavioral change(s) to narrow the gap(s) between expectations and actual performance* *Independently creates and implements a learning plan*	● Determines the decision support developed meets best practices in decision support design ● Uses peer-code review to identify programming issues ● Completes a comprehensive literature review prior to research project or system design ● Using web-based resources, creates a personal curriculum to improve evaluation of quality improvement methods
Level 4 *Intentionally seeks performance data consistently, with adaptability and humility* *Challenges assumptions and considers alternatives in narrowing the gap(s) between expectations and actual performance*	● Completes and uses peer-code review to identify ongoing programming issues ● At completion of quality improvement project, debriefs with the team members to optimize future collaboration in future quality improvement work

Uses performance data to measure the effectiveness of the learning plan and, when necessary, improves it	● Performs an audit on the design of quality improvement projects
Level 5 *Role models consistently seeking performance data with adaptability and humility* *Coaches others on reflective practice* *Facilitates the design and implementation of learning plans for others*	● Serves as a code peer-reviewer ● Develops educational module for collaboration with other team members ● Assists first-year fellows in developing their individualized learning plans
Assessment Models or Tools	● Direct observation ● Multisource feedback ● Review of learning plan
Curriculum Mapping	●
Notes or Resources	● Hojat M, Veloski JJ, Gonnella JS. Measurement and correlates of physicians' lifelong learning. *Acad Med.* 2009 Aug;84(8):1066-74. Note:Contains a validated questionnaire about physician lifelong learning. ● Kannry J, Sengstack P, Thyvalikakath TP, et al. The Chief Clinical Informatics Officer (CCIO): AMIA task force report on CCIO knowledge, education, and skillset requirements. *Appl Clin Inform.* 2016;7(1):143-76. doi: 10.4338/ACI-2015-12-R-0174. PMID: 27081413; PMCID: PMC4817341. ● Lockspeiser TM, Schmitter PA, Lane JL et al. Assessing residents' written learning goals and goal writing skill: validity evidence for the learning goal scoring rubric. *Acad Med.* 2013 Oct;88(10)1558-63.

Professionalism 1: Governance **Overall Intent:** To help establish and maintain data governance structures, policies, and processes that encompass data quality, integrity, security, access, data domain management, definitions of clinical and business cohorts, oversight and application of data standards, data provenance/lineage, metadata, and data dictionaries/definitions; to establish and/or participate in HIT governance to support strategic and financial planning, including formulation, implementation, and evaluation; to identify informatics trends, best practices, and new technologies and/or participate in governance processes to position the organization for future opportunities; to help develop organizational health informatics goals, strategies, and tactics in alignment with the organizational mission and vision	
Milestones	**Examples**
Level 1 *Attends and provides summaries of organizational informatics and/or management governance meetings*	● Attends CDS, data, or cybersecurity governance committee meetings ● Articulates and demonstrates where governance policy of the organization can be located
Level 2 *Adds meaningful contributions to ideas generated during (or in relation to) governance meetings*	● Shadows and supports leaders to understand how they plan and manage meetings ● Presents actionable ideas and examples during governance meetings
Level 3 *Contributes new ideas and tools to governance and leads subtasks/projects for the governance committee*	● Participates and/or leads a new initiative task for the governance committee ● Creates a phishing educational campaign
Level 4 *Leads work that meaningfully contributes to new policies and strategic plans*	● Reviews and revises security policies for hospitals after a ransomware attack that is presented to the governing board of a hospital or other health care organization
Level 5 *Co-leads organizational HIT governance activities*	● Plans agenda and/or leads at least one governance meeting
Assessment Models or Tools	• Direct observation • End-user evaluation
Curriculum Mapping	●
Notes or Resources	● Office of the National Coordinator for Health Information Technology. HealthIT.gov Playbook: Data Governance. https://www.healthit.gov/playbook/ambulatory-guide/data-governance/

Professionalism 2: Mentorship **Overall Intent:** To engage, educate, supervise, and/or mentor clinicians and other health care team members in their use of health information tools, systems, and processes	
Milestones	**Examples**
Level 1 *Explains the functionality of health IT systems* *Seeks out and engages with mentors*	● Explains International Organization for Standardization (ISO) Standard 13606: Electronic health record communications ● Assists with onboarding of new providers during EHR education ● Identifies areas where a mentor could be helpful, prospectively identifies and reaches out to relevant mentors
Level 2 *Provides direct support for health IT systems* *Offers support and advice to team members*	● Guides users to make changes within the EHRs CDS system (e.g., alert fatigue due to acetaminophen interactions and silencing this alert) ● Provides meaningful input to specific aspects of a team member's project
Level 3 *Participates in the development of learning materials for HIT* *Serves as a mentor to a team member or junior colleague*	● Collaborates to develop a training manual for an existing or new software implementation ● Provides prospective and ongoing support to a team member
Level 4 *Actively engages in individual and HIT systems training* *Advises mentees and supports them in development and evaluation of projects*	● Creates and presents training materials for a new or existing HIT system within a health center ● Provides in depth and continued advice and council surrounding ongoing and complex projects
Level 5 *Develops and executes user education workshops and sessions* *Manages large teams of mentees at various stages of development and leverages more senior mentees to mentor junior ones*	● Leads a workshop or educational session and measures learning outcomes to ensure users of a new or existing HIT system can use the system safely and effectively ● Creates and sustains infrastructure and processes to ensure effective 'intergenerational' mentoring focused on specific institutional goals and projects
Assessment Models or Tools	• Direct observation • Multisource feedback
Curriculum Mapping	
Notes or Resources	● Kashiwagi DT, Varkey P, Cook DA. Mentoring programs for physicians in academic medicine: a systematic review. *Acad Med.* 2013 Jul;88(7):1029-37. doi: 10.1097/ACM.0b013e318294f368. PMID: 23702518.

	● MacKenzie C, Chan TM, Mondoux S. Clinical Improvement Interventions for Residents and Practicing Physicians: A Scoping Review of Coaching and Mentoring for Practice Improvement. *AEM Educ Train.* 2019;3(4):353-364. Published 2019 Apr 24. doi:10.1002/aet2.10345 ● Straus SE, Johnson MO, Marquez C, Feldman MD. Characteristics of successful and failed mentoring relationships: a qualitative study across two academic health centers. *Acad Med*. 2013;88(1):82-89. doi:10.1097/ACM.0b013e31827647a0

Professionalism 3: Professional Behavior and Ethical Principles **Overall Intent:** To recognize and address lapses in ethical and professional behavior, demonstrates ethical and professional behaviors, and use appropriate resources for managing ethical and professional dilemmas	
Milestones	**Examples**
Level 1 *Identifies and describes potential triggers for professionalism lapses, including cultural insensitivity*	● Understands that being tired can cause a lapse in professionalism
Describes when and how to appropriately report professionalism lapses, including strategies for addressing common barriers	● Understands being late to project meetings has an adverse effect on patient care and professional relationships
Demonstrates knowledge of the ethical principles underlying the practice of clinical informatics	● Articulates how the principle of "do no harm" applies to a patient for whom decision support recommends unnecessary treatment ● Understands the risks of copying and pasting information
Level 2 *Demonstrates insight into professional behavior and cultural sensitivity in routine situations*	● Respectfully approaches a colleague who is late to a meeting about the importance of being on time
Takes responsibility for one's own professionalism lapses	● Notifies the appropriate supervisor when a colleague is routinely late
Analyzes straightforward situations using ethical principles	● Identifies and applies ethical principles to machine learning and AI ● Explores and identifies errors resulting from copying and pasting information
Level 3 *Demonstrates professional behavior and cultural sensitivity in complex or stressful situations*	● Appropriately responds to a distraught team member following an unsuccessful implementation or upgrade
Recognizes the need to seek help in managing and resolving complex ethical situations	● After noticing a colleague's inappropriate social media post, reviews policies related to posting of content and seeks guidance ● Is aware of the ethical challenges of machine learning models derived from incomplete data
Analyzes complex situations using ethical principles	● Follows up on injury to patients due to malfunctioning CDS in an ethical and comprehensive manner, including notifying patients, setting harm mitigation in motion, identifying the root cause, and addressing of the underlying problem

Level 4 *Recognizes situations that may trigger professionalism lapses and intervenes to prevent lapses in oneself and others* *Recognizes and utilizes appropriate resources for managing and resolving ethical dilemmas as needed (e.g., ethics consultations, literature review, risk management/legal consultation)*	● Actively considers the perspectives of multidisciplinary team members ● Models respect for users and promotes the same from colleagues during unanticipated down time ● Recognizes and uses ethics consults, literature, risk-management/legal counsel to resolve ethical dilemmas ● Proposes ways to mitigate errors resulting from copying and pasting information
Level 5 *Coaches others when their behavior fails to meet professional expectations* *Identifies and seeks to address system-level factors that induce or exacerbate ethical problems or impede their resolution*	● Coaches others when their behavior fails to meet professional expectations, and creates a performance improvement plan to prevent recurrence
Assessment Models or Tools	● Direct observation ● Global evaluation ● Multisource feedback ● Oral or written self-reflection ● Simulation
Curriculum Mapping	●
Notes or Resources	● American Board of Internal Medicine; American College of Physicians-American Society of Internal Medicine; European Federation of Internal Medicine. Medical professionalism in the new millennium: a physician charter. *Ann Intern Med*. 2002;136:243-246. http://abimfoundation.org/wp-content/uploads/2015/12/Medical-Professionalism-in-the-New-Millenium-A-Physician-Charter.pdf ● AMA. American Medical Association Code of Ethics. Web page. 2019. https://www.ama-assn.org/delivering-care/ama-code-medical-ethics. ● AMIA. Ethics: a code of professional ethical conduct for AMIA. Web page. https://amia.org/about-amia/leadership-and-governance/ethics. ● Bynny RL, Paauw DS, Papadakis MA, Pfeil S. Medical professionalism. Best practices: professionalism in the modern era. 2017. ISBN: 978-1-5323-6516-4. ● Domen RE, Johnson K, Conran RM, et al. Professionalism in pathology: a case-based approach as a potential education tool. *Arch Pathol Lab Med.* 2017;141:215-219. doi: 10.5858/arpa.2016-2017-CP. ● Levinson W, Ginsburg S, Hafferty FW, Lucey CR. *Understanding Medical Professionalism*. 1st ed. McGraw-Hill Education; 2014.

	● Petersen C, Berner ES, Embi PJ, et al. AMIA's code of professional and ethical conduct 2018. *J Am Med Inform Assoc* 2018;25(11):1579-1582. doi: 10.1093/jamia/ocy092. ● Tsou AY, Lehmann CU, Michel J, Solomon R, Possanza L, Gandhi T. Safe practices for copy and paste in the EHR: systematic review, recommendations, and novel model for health IT collaboration. *Appl Clin Inform.* 2017;8(1):12-34. doi: 10.4338/ACI-2016-09-R-0150. PMID: 28074211; PMCID: PMC5373750.

Professionalism 4: Accountability/Conscientiousness **Overall Intent:** To take responsibility for one's own actions and the impact on patients and other members of the health care team	
Milestones	**Examples**
Level 1 *Takes responsibility for failure to complete tasks and responsibilities, identifies potential contributing factors, and describes strategies for ensuring timely task completion in the future* *Responds promptly to requests or reminders to complete tasks and responsibilities*	● Responds promptly to reminders from supervisor to complete project reports ● Timely attendance at meetings ● Completes end-of-rotation evaluations
Level 2 *Performs tasks and responsibilities in a timely manner with appropriate attention to detail in routine situations* *Recognizes situations that may impact one's own ability to complete tasks and responsibilities in a timely manner*	● Completes administrative tasks Including individualized learning plans and other documentation pertaining to educational and training experiences ● Clearly communicates hand-offs within team projects
Level 3 *Performs tasks and responsibilities in a timely manner with appropriate attention to detail in complex or stressful situations* *Proactively implements strategies to ensure that the needs of patients, teams, and systems are met*	● Notifies program faculty members of multiple competing demands, appropriately triages tasks, and asks for assistance from other fellows, team members, or faculty members, as needed ● Arranges coverage for an assigned project and/or other tasks when preparing for time out of the office
Level 4 *Recognizes situations that may impact others' ability to complete tasks and responsibilities in a timely manner* *Monitors and improves strategies to ensure that the needs of patients, teams, and systems are met*	● Takes responsibility for inadvertently omitting key project-related information with fellows, team members, or faculty members ● Communicates prospectively with team members related to project-related tasks and deadlines
Level 5 *Takes ownership of system outcomes* *Takes ownership of personal and team failures*	● Sets up a meeting with project team members to overcome obstacles and improve performance
Assessment Models or Tools	● Direct observation

	● Multisource feedback ● Global evaluations ● Self-evaluations and reflective tools ● Compliance with deadlines and timelines ● Simulation
Curriculum Mapping	●
Notes or Resources	● AMIA. Ethics: a code of professional ethical conduct for AMIA. Web page. https://amia.org/about-amia/leadership-and-governance/ethics https://amia.org/about-amia/leadership-and-governance/ethics ● Code of conduct from fellow/resident institutional manual ● Expectations of fellowship program regarding accountability and professionalism ● Petersen C, Berner ES, Embi PJ, et al. AMIA's code of professional and ethical conduct 2018. *J Am Med Inform Assoc* 2018;25(11):1579-1582. doi: 10.1093/jamia/ocy092.

Professionalism 5: Self-Awareness and Help-Seeking **Overall Intent:** To identify, use, manage, improve, and seek help for personal and professional well-being for self and others	
Milestones	**Examples**
Level 1 *Recognizes the status of personal and professional well-being, with assistance*	• Acknowledges own response to project difficulties or failures
Level 2 *Independently recognizes the status of personal and professional well-being*	• Independently identifies and communicates impact of project failure and lessons learned
Level 3 *With assistance, proposes a plan to optimize personal and professional well-being*	• With support from colleagues and faculty members, develops a reflective response to deal with personal impact of difficult team interactions and/or project failures
Level 4 *Independently develops a plan to optimize personal and professional well-being*	• Independently identifies ways to manage personal stress
Level 5 *Coaches others when emotional responses or limitations in knowledge/skills do not meet professional expectations*	• Assists in organizational efforts to address clinician well-being due to EHR burden • Works with multidisciplinary team to develop a feedback framework for learners around project meetings
Assessment Models or Tools	• Direct observation • Self-assessment and personal learning plan • Individual interview • Group interview or discussions for team activities • Institutional online training modules
Curriculum Mapping	•
Notes or Resources	• This subcompetency is not intended to evaluate a fellow's well-being, but to ensure each fellow has the fundamental knowledge of factors that impact well-being, the mechanisms by which those factors impact well-being, and available resources and tools to improve well-being. • Local resources, including Employee Assistance Programs • ACGME. ACGME Well-Being Tools and Resources. https://dl.acgme.org/pages/well-being-tools-resourcesHicks PJ, Schumacher D, Guralnick S, Carraccio C, Burke AE. Domain of competence: personal and professional development. *Acad Pediatr*. 2014 Mar-Apr;14(2 Suppl):S80-97.

Interpersonal and Communication Skills 1: Communicate Effectively with Multiple Constituencies **Overall Intent:** To demonstrate effective communication, negotiation, and conflict resolution skills; to promote collaboration with health care team members, patients, members of the care community, external organizations, and vendors	
Milestones	**Examples**
Level 1 *Effectively uses an online team communication tool* *Demonstrates culturally sensitive communications*	● Facilitates use of secure texting to transmit clinical data for one or more patients ● Demonstrates knowledge of cultural issues related to configuration and use of patient portals and/or secure text messaging
Level 2 *Creates a logical argument to propose a new project* *Sets up culturally sensitive communication by the team, project, and subproject*	● Proposes a project to communicate with patients who need a service for their health maintenance, e.g., a colonoscopy or mammogram ● Proposes a project to use culturally sensitive language to communicate these health needs to underrepresented communities and to evaluate the efficacy of the technique
Level 3 *Writes a project proposal that is approved by the administration* *Generates a culturally sensitive project proposal that is approved by the administration*	● Develops an implementation strategy and evaluation tools and presents the project proposal at a management committee ● Demonstrates cultural awareness in the design and proposed implementation of a project
Level 4 *Implements the results of a project into practice* *Implements a culturally sensitive project in clinical practice*	● Implements and evaluates the project; resolves conflict between stakeholders ● Builds methods into the implementation strategy that are culturally aware and provides a strategy for implementing these methods in the practice. (e.g., intervention considers some of the social determinants of health)
Level 5 *Demonstrates practice improvement through team science and team medicine* *Demonstrates the effectiveness of a culturally sensitive practice improvement project*	● Evaluates the implementation and its positive and negative effects on the practice ● Disseminates the results of the evaluation ● Shows that the cultural awareness built into the implementation strategy improves its efficacy for underrepresented communities
Assessment Models or Tools	● Direct observation ● Multisource feedback
Curriculum Mapping	●
Notes or Resources	● Fisher R and Ury W. *Getting to Yes: Negotiating Agreement without Giving In.* New York, NY: Houghton Mifflin Company; 1981.

	● Leonard, K. (2015). *Yes, and: How improvisation reverses "no, but" thinking and improves creativity and collaboration : lessons from The Second City* (First edition.). New York, NY: HarperBusiness, an imprint of HarperCollinsPublishers. ● Voss C, Raz T. *Never Split the Difference*. London, England: Random House Business Books; 2017.

Interpersonal and Communication Skills 2: Building Consensus **Overall Intent:** To build support and create alignment for informatics best practices to ensure all stakeholders are active, visible sponsors of informatics within their respective roles; to use change management techniques to implement and optimize HIT systems that promote adoption and use by health professionals	
Milestones	**Examples**
Level 1 *Identifies stakeholders* *Contributes to the creation of a project vision*	● Presents a list of stakeholders for a new module implementation or changes to an existing HIT tool ● Identifies key issues for stakeholders for a specific project
Level 2 *Creates targeted messaging for each stakeholder* *Communicates vision of the project*	● Creates targeted messaging regarding downtime to different stakeholder groups, including patients, administrators, and care providers ● Articulates the rationale and importance of pediatric dosing algorithm and decision supports
Level 3 *Delivers messages to stakeholders in multi-modal fashion and receives feedback* *Participates in governance*	● Uses electronic communications that are culturally sensitive for each stakeholder group ● Participates in HIT governance committees planning an implementation of a new or upgraded HIT system
Level 4 *Coordinates discussions to resolve conflict across stakeholders* *Inspires and motivates others to accept change*	● Mediates various stakeholder opinions to create discussions of each stakeholder groups' points of view with respect to an active implementation issue (e.g., which non-critical alerts to include in a clinical decision support system)
Level 5 *Builds consensus that is operationalized in the health system* *Evaluates change and pursues opportunities for improvement*	● Demonstrates the ability to build consensus within and between stakeholder groups with respect to an implementation issue (e.g., gain consensus on which alerts that might be important but have low specificity should be included in the CDS system ● Evaluates the over-ride rate of the CDS system before and after the implantation of new CDS change
Assessment Models or Tools	• Direct observation • Multisource feedback
Curriculum Mapping	●
Notes or Resources	● Office of the National Coordinator for Health Information Technology. HealthIT.gov. Health IT Curriculum Resources for Educators: Working in Teams. https://files.healthit.gov/Component_17/Comp17_ComponentGuide.docx

To help programs transition to the new version of the Milestones, the ACGME has mapped the original Milestones 1.0 to the new Milestones 2.0. Indicated below are where the subcompetencies are similar between versions. These are not exact matches but are areas that include similar elements. Not all subcompetencies map between versions. Inclusion or exclusion of any subcompetency does not change the educational value or impact on curriculum or assessment.

Milestones 1.0	Milestones 2.0
PC1: Technology Assessment	
PC3: Impact of Clinical Informatics on Patient Care	
PC5: Information Systems Lifecycle	
PC6: Assessing User Needs	
MK1: Clinical Informatics Fundamentals and Programming	
MK2: Leadership and Change Management	
SBP1: Patient Safety and Unintended Consequences	
SBP2: Resource Utilization	
SBP3: Workflow and Data Warehouse/Repository	
PBLI1: Recognition of Errors and Discrepancies	
PBLI2: Analyzes and appraises pertinent literature, applies scientific method to identify, interprets evidence-based medicine, and applies it clinically	
ICS2: Communication with Patients and Families	
	PC1: Consumer Informatics Applications, Portals, And Telehealth
	PC2: Emerging Data Sources
PC4: Project Management	MK1: Project Management
	MK2: Implementations/Health Information Technology (HIT) Knowledge
	SBP1: Health Information Technology (HIT) Knowledge of Current and New Testing, Implementation, Monitoring
	SBP2: Standards and Interoperability
PROF5: Professionalism — Understands and practices information security and privacy	SBP3: Data Integrity/Security

	PBLI1: Optimization, Downtime, Functional Requirements
PC2: Clinical Decision Support	PBLI2: Clinical Decision Support (CDS)
	PBLI3: Analytics:
	PBLI4: Human-Computer Interaction (HCI) and User Interfaces (UI)
PROF3: Professionalism — Gives and receives feedback	PBLI5: Reflective Practice and Commitment to Personal Growth
	PROF1: Governance
	PROF2: Mentorship
PROF1: Professionalism - Demonstrates honesty, integrity, and ethical behavior	PROF3: Professional Behavior and Ethical Principles
PROF2: Professionalism — Demonstrates responsibility and follow-through on tasks PROF4: Professionalism — Demonstrates responsiveness and sensitivity to individuals' distinct characteristics and needs	PROF4: Accountability/Conscientiousness
	PROF5: Self-Awareness and Help-Seeking
ICS1: Effective Communications with Interprofessional Teams	ICS1: Communicate Effectively with Multiple Constituencies
	ICS2: Building Consensus

Available Milestones Resources

Milestones 2.0: Assessment, Implementation, and Clinical Competency Committees Supplement, new 2021 - https://meridian.allenpress.com/jgme/issue/13/2s

Clinical Competency Committee Guidebook, updated 2020 - https://www.acgme.org/Portals/0/ACGMEClinicalCompetencyCommitteeGuidebook.pdf?ver=2020-04-16-121941-380

Clinical Competency Committee Guidebook Executive Summaries, new 2020 - https://www.acgme.org/What-We-Do/Accreditation/Milestones/Resources - Guidebooks - Clinical Competency Committee Guidebook Executive Summaries

Milestones Guidebook, updated 2020 - https://www.acgme.org/Portals/0/MilestonesGuidebook.pdf?ver=2020-06-11-100958-330

Milestones Guidebook for Residents and Fellows, updated 2020 - https://www.acgme.org/Portals/0/PDFs/Milestones/MilestonesGuidebookforResidentsFellows.pdf?ver=2020-05-08-150234-750

Milestones for Residents and Fellows PowerPoint, new 2020 -https://www.acgme.org/Residents-and-Fellows/The-ACGME-for-Residents-and-Fellows

Milestones for Residents and Fellows Flyer, new 2020 https://www.acgme.org/Portals/0/PDFs/Milestones/ResidentFlyer.pdf

Implementation Guidebook, new 2020 - https://www.acgme.org/Portals/0/Milestones%20Implementation%202020.pdf?ver=2020-05-20-152402-013

Assessment Guidebook, new 2020 - https://www.acgme.org/Portals/0/PDFs/Milestones/Guidebooks/AssessmentGuidebook.pdf?ver=2020-11-18-155141-527

Milestones National Report, updated each Fall - https://www.acgme.org/Portals/0/PDFs/Milestones/2019MilestonesNationalReportFinal.pdf?ver=2019-09-30-110837-587 (2019)

Milestones Bibliography, updated twice each year - https://www.acgme.org/Portals/0/PDFs/Milestones/MilestonesBibliography.pdf?ver=2020-08-19-153536-447

Developing Faculty Competencies in Assessment courses - https://www.acgme.org/Meetings-and-Educational-Activities/Other-Educational-Activities/Courses-and-Workshops/Developing-Faculty-Competencies-in-Assessment

Assessment Tool: Direct Observation of Clinical Care (DOCC) - https://dl.acgme.org/pages/assessment

Assessment Tool: Teamwork Effectiveness Assessment Module **(TEAM) -** https://dl.acgme.org/pages/assessment

Learn at ACGME has several courses on Assessment and Milestones - https://dl.acgme.org/