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INNOVATION

An Exemplar Milestone Framework for Scaffolding a Competency-Based Medical School Curriculum

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Abstract
A strong competency and milestone framework is imperative for medical schools adopting competency-based education and assessment. Milestones can be used to align what is taught and what students are asked to demonstrate from matriculation to graduation. We describe the creation and implementation of our milestone framework as an exemplar.

Keywords Medical schools · Milestone framework · Competency-based education

Body

Competency-based education challenges medical schools to establish longitudinal performance expectations, assessment systems, and mechanisms for determining progression across a multidisciplinary, often siloed, curriculum. National models for undergraduate and graduate medical education competencies in the USA do not align neatly, increasing the complexity of the task. Herein, we describe the competencies and milestones developed for one school's new competency-based curriculum, in the hopes that the model may assist other schools in their work.

For context, the Michigan State University College of Human Medicine (CHM) is a community-based medical school founded in 1964. Cohorts of 200 students are assigned across two campuses (i.e., Grand Rapids and East Lansing) for the first 2 years of the curriculum, and then to seven community campuses across the state (i.e., Flint, Grand Rapids, Lansing, Midland, Southeast Michigan, Traverse City, and the Upper Peninsula) for the second 2 years. CHM launched its new Shared Discovery Curriculum (SDC) in 2016. The curriculum features semester-long courses integrating necessary science knowledge and clinical experiences, early workplace-based clinical experiences, and interactive small and large group activities delivered within a learning society structure [1]. Students in the Early Clinical Experience (first 24 weeks) undergo intensive simulation training before being placed in primary care clinics at week nine. In clinics, they room patients, perform basic procedures such as immunizations, and complete a scholarly or quality project. In flipped classrooms, laboratories, and formative simulation, they focus on the scientific and clinical knowledge for chief complaints common in primary care, such as abdominal pain, depression, and joint pain. In the 30-week-long Middle Clinical Experience, students are assigned to rotations in inpatient and ambulatory settings working within medical or interdisciplinary teams (i.e., Adult Wards, Ambulatory Direct Care, Care Management and Social Work, Emergency Medicine, Newborn Service, Nursing, Nutrition, Palliative Care and Pain, Pediatric Wards, Pharmacy, Physical Therapy, Respiratory Therapy, and Women's Health). Clinical experiences are complimented by weekly rotational small groups and formative simulation sessions, while scholar groups cover additional chief complaints. Students are also assigned to 12 weeks of

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Table 1 Criteria for care of patients for first semester of the middle clinical experience

Care of patients	Routinely collected evidence	Portfolio
1. Demonstrates kindness and compassion to patients and their families — accounts for 1% of C	• **Progress clinical skills examination interactional skills** — accounts for 100% of C1	• n/a
2. Collects complete and accurate patient data — accounts for 40% of C	• **Progress clinical skills examination history gathering** — accounts for 30% of C1 •**Progress clinical skills examination physical exam** — accounts for 30% of C1	• **5 clinical checklists not required for a rotation** (minimum 5 different types of checklists with full credit for all required items) — accounts for 25% of C2 •**Rotational clinical checklists** (requirements vary by rotation) — accounts for 15% of C2
3. Synthesizes patient and laboratory data to formulate reasonable assessments and plans — accounts for 14% of C	• **Progress clinical skills examination post encounter tasks** — accounts for 40% of C3	• **2 Scholar group presentation** rubrics completed by preceptor: accounts for 30% • **2 De-identified written records** (H&P or SOAP note) from authentic patients — accounts for 30% of C3
4. Demonstrates the incorporation of patient values into illness assessment and care plans — accounts for 15% of C	• **Progress clinical skills examination interactional skills** — accounts for 30% of C4 • **Progress clinical skills examination counseling** — accounts for 20% of C4 • **Non-clinical preceptor assessment**: "Protects patient confidentiality" — accounts for 14% of C4 • **Peer assessment:** "Protects patient confidentiality" — accounts for 14% of C4	• **2 De-identified written records** (H&P or SOAP note) from authentic patients — accounts for 22% of C4
5. Communicates effectively in writing and orally — accounts for 25% of C	• **Progress clinical skills examination interactional skills** — accounts for 25% of C5 • **Progress clinical skills examination counseling** — accounts for 15% of C5	• **2 Scholar group presentation** rubrics completed by preceptor — accounts for 30% • **2 De-identified written records** (H&P or SOAP note) from authentic patients — accounts for 30% of C5
6. Effectively counsels and educates patients and their families — accounts for 5% of C	• **Progress clinical skills examination counseling** — accounts for 100% of C6	

Total contribution to competency by assessment type: clinical skills checklists 10%, non-clinical preceptor 2.1%, peer 2.1%, PCSE interactional skills 11.8, PCSE history-gathering 12%, PCSE physical exam 12%, PCSE post encounter 5.6%, rotational checklists C 6%, scholar group presentations 11.7%, written records 15%

mini-courses, or intersessions, between Early and Middle Clinical Experiences, and 8 weeks after the Middle Clinical Experience. After passing USMLE Step 1, students transition to community campuses for the Late Clinical Experience, featuring departmental clerkships and semester-long courses that incorporate core skills and knowledge development with competency-based assessments.

The college needed a strong framework to scaffold its curricular experiences and assessment strategies for this complex endeavor. Curricular leaders elaborated the college's pre-existing competencies (Service, Care of Patients, Rationality, Integration, Professionalism, and Transformation, or SCRIPT) into milestones. This was done after the general structure of the curriculum was determined but before all the content of individual courses was finalized. We mapped milestones to courses prospectively, aligning experiences and assessments longitudinally.

The milestones are aligned with the Association of American Medical College's (AAMC) Core Entrustable Professional Activities (EPAs) [2] and the Accreditation Council for Graduate Medical Education's (ACGME) milestones [3]. They describe a behavioral trajectory from novice to competent using a framework analogous to the ACGME's, anchored by a set of critical deficiencies or "never events" for student behavior. "Competent" is aligned with the lowest level of the ACGME Core Competencies, generally attained during the first postgraduate year, where applicable.

Milestones are mapped to the courses by which they should be achieved (Appendix 1), with corresponding sources of evidence specified within course syllabi. Assessment data derive from the Progress Clinical Skills Examination (PCSE), the Comprehensive Necessary Science Examination (CNSE), multisource feedback, workplace-based assessments, direct observations, and portfolio artifacts. The PCSE and CNSE occur twice per semester, while other assessment use varies (Appendix 1). Individual assessments are weighted and mapped to competencies for course syllabi and student dashboards. In the example provided (Table 1), the assessments each contribute between 2.1 and 15% to Care of Patients.

Multiple streams of student data, such as those in Table 1, are integrated using a cloud-based dashboard, JustInTime (justintimemedicine.com). Students, faculty coaches, course directors, and the Student Competence Committee (SCC) visualize data to inform individual learning plans, course grades, and progression in the curriculum.

Students must reach a threshold score (80%) for each of the six SCRIPT competencies, as calculated on the dashboard, to pass the course. The SCC reviews the quantitative and qualitative data to determine if any critical deficiencies (Appendix 1) are present. If so, the critical deficiency supersedes dashboard arithmetic and results in a non-passing grade. Non-passing grades are remediated within the next semester by meeting expectations for the specific areas of deficiency noted (e.g., scientific knowledge and the CNSE, professionalism and multisource feedback). Remediation of professionalism often includes self-reflection and plans for ensuring future behavior meets expectations.

The full 10 semesters of the curriculum have been implemented. The SCC has recommended approximately 7,400 grades as of January 2022. Non-passing grades have been issued, primarily for Professionalism (e.g., "Fulfills responsibilities in courses and on clinical rotations") and Transformation (e.g., "Applies essential basic, social, clinical science and systems knowledge in the care of patients") as early as the first semester of the curriculum. Most students have remediated their deficiencies and progressed through the curriculum successfully.

We collect longitudinal data on students and cohorts using our milestones and assessments rooted in the real work of physicians. The data allow us to predict student performance (e.g., CNSE scores and subsequent USMLE Step scores), provide additional support for students at risk academically, and ensure the alignment of our milestones and curricular experiences. For example, the milestones helped us adapt to disruptions from the COVID-19 pandemic. We quickly identified and closed gaps, whether by adding additional clinical time later and/or creating alternative assessments (e.g., virtual PCSE) to use until in-person activities resumed. We did not lower our standards for any course.

We have encountered a variety of challenges in gathering and interpreting our comprehensive, longitudinal data. For example, assessments unique to our institution were designed with content validity, but we are still gathering content and predictive validity for some. The PCSE is time- and labor-intensive for our two simulation sites and requires students in the third and fourth years to travel up to 400 miles. It has been challenging to develop more than 3,000 faculty members across our campuses in completing direct observations.

Despite these logistical issues, we can populate the Medical Student Performance Evaluation with robust performance data on key clinical functions (e.g., history-gathering, physical examination, and safety behaviors) and performance on the CNSE. Two cohorts of students have graduated as of May 2021 with successful residency placement; initial responses to program director surveys are promising.

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Declarations

Ethics Approval N/A.

Consent to Participate N/A.

Conflict of Interest The authors declare no competing interests.

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