The Clinical Microsystems Clerkship at University of California, San Francisco: Integrating Clinical Skills and Health Systems Improvement for Early Medical Students

Anna Chang, MD, Edgar Pierluissi, MD, Susannah Cornes, MD, Allison Ishizaki, MPH, Arianne Teherani, PhD, John A. Davis, PhD, MD, Karen E. Hauer, MD, PhD, and Catherine R. Lucey, MD

Abstract

Problem

Medical educators recognize that partnering actively with health system leaders closes significant health care experience, quality, and outcomes gaps. Medical schools have explored innovations training physicians to care for both individual patients and populations while improving systems of care. Yet, early medical student education fails to include systems improvement as foundational skills. When health systems science is taught, it is often separated from core clinical skills.

Approach

The Clinical Microsystems Clerkship at the University of California, San Francisco School of Medicine, launched in 2016, integrates clinical skills training with health systems improvement from the start of medical school. Guided by communities of practice and workplace learning principles, it embeds first-year and second-year students in longitudinal clinical microsystems with physician coaches and interprofessional clinicians one day per week. Students learn medical history, physical examination, patient communication, interprofessional teamwork, and health systems improvement. Assessments include standardized patient examinations and improvement project reports. Program outcome measures include student satisfaction and attitudes, clinical skills performance, and evidence of systems improvement learning, including dissemination and scholarship.

Outcomes

Students reported high satisfaction (first-year, 4.10; second-year, 4.29, on a scale of 1–5) and value (4.14) in their development as physicians. Clinical skills assessment accuracy was high (70%–96%). Guided by interprofessional clinicians across 15 departments, students completed 258 improvement projects in 3 health systems (academic, safety net, Veterans Affairs). Sample projects reduced disparities in hypertension, improved opiate safety, and decreased readmissions. Graduating students reported both clinical skills and health systems knowledge as important to physician success, patient experience, and clinical outcomes (4.73). Most graduates discussed their projects in residency applications (85%) and disseminated related papers and presentations (54%).

Next Steps

Integrating systems improvement, interprofessional teamwork, and clinical skills training can redefine early medical student education. Health system perspectives, long-term outcomes, and sustainability merit further exploration.

Problem

Three problems inhibit early medical students' understanding of health systems science as essential for physician practice.[1] First, health systems learning, if it occurs, is often conceptual, occasional, elective, and separate from the now mostly integrated core foundational science and clinical skills curricula.[2] Second, early medical student learning communities are situated in classrooms, rather than grounded in the messy realities of clinical health systems. Third, classroom-based learning does not sufficiently bolster development of the physician mindset until entry to clerkships.[3] Even early medical student education should "adequately represent the integrated nature of physicians' learning and work."[3] Educators are challenged to help all medical students from the start to experience the physician's obligation to patients, teams, and health systems in authentic workplace learning, embedded in longitudinal communities of practice.

The Carnegie Foundation guides educators by endorsing medical education reforms intended to produce physicians competent to care for individual patients and able to collaborate with interprofessional teams to improve systems of care.[3] A call to action was made by Berwick: "In addition to understanding the biological basis of health and disease, and mastering technical skills for treating individual patients, physicians will need to learn to navigate in and continually improve complex systems in order to improve the health of the patients and communities they serve."[4] At the core of these reforms is meaningful integration of direct patient care with team-based health systems improvement.[5] However, physicians do not experience this role integration in training.[3] What is missing is a contextualization of health systems science as essential to being a physician,

Please see the end of this article for information about the authors.

Correspondence should be addressed to Anna Chang, 490 Illinois St., Floor 8, UCSF Box 1265, San Francisco, CA 94143-2510; telephone: (415) 476-6189; email: anna.chang@ucsf.edu.

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intertwined with patient care. These gaps are particularly evident in early medical student education.

To address these gaps, we developed an early medical student curriculum that mirrors physician practice by integrating clinical skills training and health system improvement, guided by communities of practice and workplace learning principles. Integration, improvement, identity formation, and individualization of learning with standardization of outcomes—themes developed by Cooke, Irby, and O'Brien[3]—served as key pillars. To our knowledge, there are no comparable published reports. We describe a novel program that embeds all first-year and second-year medical students in longitudinal team-based workplace learning communities for clinical skills and health systems training.

Approach

The University of California, San Francisco (UCSF) School of Medicine's Clinical Microsystems Clerkship (CMC) is a required clinical skills and health systems course occurring one full day per instructional week across the first 17 months of medical school (Figure 1).

Program overview

The CMC integrates clinical practice and team-based health systems science from the start of medical school. In parallel to the physician workday, it colocates clinical practice and systems improvement learning in the same day with the same team. Building blocks include patient care skills training, health systems improvement projects, and interprofessional communities of practice. Students contribute as authentic team members to health systems improvement at 3 health systems (academic medical center, public safety net health system, Veterans Affairs). Longitudinal workplace learning communities consist of 5 or 6 medical students per physician faculty coach in a clinical microsystem. For example, students working with an anesthesiologist might see preoperative patients in the morning and work to improve perioperative opiate management processes in the afternoon.

Design and implementation

We launched the CMC in 2016 as part of a major curriculum transformation effort (see Supplemental Digital Appendix 1, at http://links.lww.com/ACADMED/B332). We convened a team of education leaders and health system stakeholders to develop the vision during the 4-year design period, and to offer regular feedback in continued partnership after implementation.[6] For alignment, each student is clinically onboarded to the medical record system where they are assigned, and apply the same systems improvement framework as clinicians in the health system. We used curricular timing intentionally to advance integration. For example, clinical topics such as cardiopulmonary pathophysiology are presented along with published descriptions of improvement efforts in cardiology. The CMC leadership team has 9 faculty directors (total of 2 FTE): 1 course director, 1 faculty development codirector, 2 clinical skills codirectors, 2 health systems codirectors, and 3 clinical site directors. These faculty lead curricular design and faculty development for 55 physician coaches (0.2 FTE each) and additional educators. Faculty development averages 4 hours per month, along with monthly educator community meetings and biannual faculty development days. Clinical skills faculty development occurs in small groups, sometimes with content experts, standardized patients, or simulation equipment. Coaches receive intensive individual guidance in selecting health systems improvement projects aligned with health system goals. Student performance data reflecting progress toward UCSF School of Medicine competencies are shown in their academic dashboards. The CMC is implemented by 6 full-time administrative staff members.

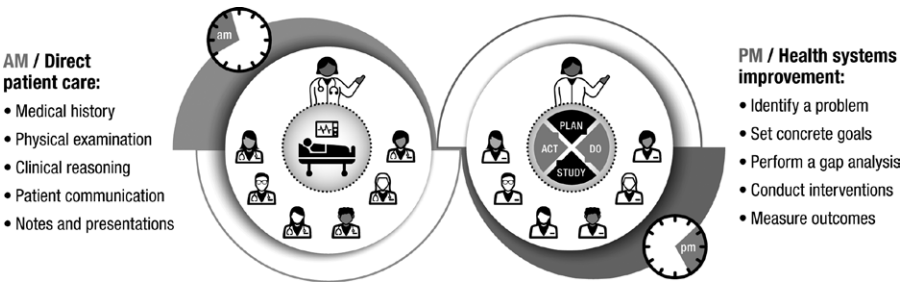

Figure 1 The UCSF CMC instructional day. One half-day primarily focuses on direct patient care, with individual patients at the center of the workplace learning community, and the other half-day primarily focuses on health systems improvement, with the interprofessional team and health system at the center of longitudinal improvement efforts. Clinical microsystems include these departments and subspecialties: anesthesia, dermatology, emergency medicine, family medicine, internal medicine, neurology, obstetrics–gynecology, orthopedics, otolaryngology, pediatrics, psychiatry, radiology, radiation oncology, surgery, and urology. Abbreviations: UCSF, University of California, San Francisco; CMC, Clinical Microsystems Clerkship.

Clinical skills curriculum and assessments

The direct patient care curriculum provides foundational skills for medical history, physical examination, clinical reasoning, patient communication, note-writing, and oral presentations. The curriculum begins with 3 hours of introductory lectures and associated small group discussions followed by a clinical immersion week where students spend time in their assigned clinical microsystem learning about the patient population, patient experience, and interprofessional clinical practice. The remainder of the clinical skills curriculum, approximately one half-day per instructional week, consists of hands-on practice in small groups with standardized patient simulation and individually in clinical preceptorships. Students undergo direct observation, receive feedback, and develop individual learning goals longitudinally with physician coaches. Following formative assessments, summative demonstration of clinical skills examinations occur at the end of year 1 and year 2. Scoring checklists designed by experienced physician educators are completed by standardized patients, modeled after the California Consortium for the Assessment of Clinical Skills examinations and published guidelines for the prior United States Medical Licensing Examination Step 2 Clinical Skills Examinations.

Systems improvement curriculum and assessments

The systems improvement curriculum identifies health disparities as an ideal focus of student improvement efforts.

It begins with 4 hours of foundational lectures and associated small-group discussions on quality improvement and health disparities. During the clinical immersion week, students hear from health system chief executive officers, health system quality improvement leaders, and interprofessional team members. Early in the first year, students affirm their quality improvement knowledge with the Quality Improvement Knowledge Application Tool (Revised). One half-day each week for the remainder of the curriculum, students work on a quality improvement project designed to address institutional priorities using the 7 steps of Lean A3 continuous improvement: background, problem identification, aim statement, gap analysis, countermeasure implementation, program evaluation, and lessons learned reflections. Formative and summative skills assessments are based on a project template submitted at 4 time points, culminating in a final poster or oral presentation to education deans and health system leaders. Each submission is independently reviewed by 2 faculty physicians based on Lean A3 guidelines, generating comments for improvement. Students also receive feedback on their communication and teamwork skills from interprofessional clinical colleagues.

Outcomes

We present data corresponding to the 4 Kirkpatrick Model levels (reaction, learning, behavior, and results).[7]

Five-year cumulative course data

Five classes of medical students (n = 776) have completed the CMC since launch. Student satisfaction with the CMC was 4.05 (SD = 0.18) on a scale of 1 (poor) to 5 (excellent) (Kirkpatrick level 1). Students completed 258 improvement projects in 15 clinical departments across 3 health systems, working with interprofessional team members from all allied health professions (Kirkpatrick level 3). When asked whether being a health care team member is vital to their work as physicians, graduating medical students who completed the CMC selected this future role as a priority at twice the rate than those who underwent the prior curriculum (23% vs 12%; n = 34/149 vs 25/210). Second-year students advanced to clerkships at a similar rate compared with previous classes (data not reported).

Single class in-depth analysis

The CMC achieved comparable outcomes each year from 2016 to 2021, with minor fluctuations. We present an in-depth analysis of the class of 2021 (n = 152), which had the most longitudinal data. Evaluation data show that early medical students considered the quality of the integrated CMC course to be high and valued its contributions to their development as physicians (Kirkpatrick level 1) (Table 1 and Supplemental Digital Appendix 2, at http://links.lww.com/ACADMED/B332). Students performed well in summative assessments (Kirkpatrick levels 2 and 3) (Table 2). Anecdotally, both students and faculty perceived students to be well prepared for clerkships and noted students' increased familiarity with navigating the health system and interacting with clinical teams (data not reported). In addition, each class of students contributed more than 15,000 hours of effort to health system improvement initiatives. Fifteen sample student projects show the range of clinical settings, improvement aims, and systems outcomes (Kirkpatrick level 4) (Supplemental Digital Appendix 3, at http://links.lww.com/ACADMED/B332). Graduating students reported strong belief (4.73 on a scale of 1–5) that both direct patient care and health systems skills are important to the physician role and patient outcomes (Kirkpatrick level 1) (Supplemental Digital Appendix 4, at http://links.lww.com/ACADMED/B332). Most graduates (85%) listed their CMC health systems improvement work in their residency applications, and half (54%) disseminated scholarship such as papers and presentations (Kirkpatrick level 3). All Medical Student Performance Evaluations include a summary of the student's CMC project.

Benefits of CMC integrated training

The CMC, a novel early medical student curriculum integrating clinical skills training and health systems improvement in longitudinal workplace learning communities, addresses all areas of the Carnegie call for educational reform, including curricular integration, improvement science, individualized learning, standardized outcomes, and a reframing of physician professional identity.[3,8] Program data show high satisfaction, high perceived value, expected learning, behavior change, and positive health systems outcomes.

Table 1

Clinical Microsystems Clerkship Quantitative Program Evaluation Data, Kirkpatrick Level 1 (Reaction): Single Class In-Depth Analysis, University of California, San Francisco, School of Medicine, 2021[a]

	MS1		MS2	
Student evaluation	**No.[b]**	**Mean[c] (SD)**	**No.[b]**	**Mean[c] (SD)**
Quality and value				
Overall course quality	49	4.10 (0.92)	48	4.29 (0.74)
Value of the clinical skills curriculum	48	4.60 (0.54)	48	4.65 (0.64)
Value of the health systems curriculum	48	3.25 (0.91)	45	3.91 (0.97)
Professional development				
Value to students' development as physicians	50	4.14 (0.86)	50	4.14 (0.93)

Abbreviations: MS1, first-year medical students; MS2, second-year medical students; SD, standard deviation.
[a]Data were collected via email survey of [no.] students, with a 100% response rate. Not all participants responded to all questions.
[b]Random sampling of one-third of the class per evaluation program policy.
[c]Mean rating is on a 5-point scale (1 = poor, 5 = excellent).

Table 2

Clinical Microsystems Clerkship Student Assessment Data, Kirkpatrick Levels 2 (Learning) and 3 (Behavior): Single Class In-Depth Analysis, University of California, San Francisco, School of Medicine, 2021

Student assessment	MS1 (n = 152)	MS2 (n = 152)
Clinical skills: standardized patient examinations, mean percentage (SD)[a]		
Patient communication	90 (5.3)	86 (5.7)
Medical history	85 (5.9)	96 (4.6)
Physical examination	78 (6.2)	70 (7.4)
Interprofessional collaboration: feedback, percentage of all students[b]		
Communication and teamwork	98	n/a
Health systems: knowledge tests, percentage of all students[c]		
QIKAT-R[d]	80	n/a
Health systems: improvement project, percentage of all students[c]		
Background, problem, aims	90	n/a
Gap analysis	93	n/a
Interventions and measurement	n/a	88
Reflections	n/a	100

Abbreviations: MS1, first-year medical students; MS2, second-year medical students; SD, standard deviation; n/a, not applicable; QIKAT-R, Quality Improvement Knowledge Application Tool Revised.
[a]Clinical skills examinations are 6-station standardized patient examinations. Mean indicates percentage correct on checklist items developed by physician faculty and graded by standardized patients.
[b]Interprofessional feedback was requested by students and completed by a clinical team member (nurses, pharmacists, psychologists, dentists, dieticians, social workers, occupational therapists, physical therapists, respiratory therapists, informatics officers, medical assistants, patient navigators, quality and safety managers, informatics officers, environmental services staff, and community health workers); 49% had > 5 days of contact, 30% had > 9 days of contact, 12% had > 15 days of contact. Percentages indicate students who received feedback (the remainder completed a reflection exercise under the guidance of their physician coach).
[c]Health systems improvement knowledge is assessed with the QIKAT-R, which are validated paper cases revised locally to clarify medical language for early medical students. Health systems improvement project skills are assessed with a Lean A3 health systems improvement project template. Percentage indicates students who met expectations on first submission (the remainder revised and met expectations on resubmission). Meeting expectations on the QIKAT-R is a score of 6 or higher on a 9-point scale. Meeting expectations in the project background, problem, and aim includes quantification of the problem compared with a benchmark standard and articulating the target goal using the SMART (specific, measurable, attainable, relevant, and timely) framework. Meeting expectations on the gap analysis includes the application of a gap analysis tool (e.g., 5 why's or fishbone diagram). Meeting expectations on interventions and measurement includes providing a rationale for why an intervention was chosen based on effect size and resources needed as well as a description of outcomes measured. Meeting expectations on project reflection includes descriptions of barriers and facilitators and suggestions for next steps for the project.
[d]Singh MK, Ogring G, Cox K, et al. The Quality Improvement Knowledge Application Tool Revised (QIKAT-R). Acad Med. 2014;89:1386–1391.

Learning health systems integrate clinical science and systems science, connecting care delivery and continuous improvement.[9] This is often overlooked in early medical student education. To address this gap, we advanced integration through colocation in time (the same instructional day) and space (the same clinical microsystem). In parallel to the integration of basic and clinical sciences, integration between clinical sciences and health systems science can also begin early in undergraduate medical education.[3]

By engaging early students in longitudinal workplace learning, the CMC supports the development of "identity alongside competency" by helping medical students consolidate who they are in relation to their community of practice.[10] This approach may also limit the imperial stage (where learners' own needs predominate), giving way to an interpersonal stage (where self-interest is subordinated).[8] This strategy moves up the timeline for physician professional identity development from entry to clerkships to the start of medical school.[3]

For health systems, this program demonstrates how early trainees can improve outcomes while learning "habits of mind and heart that continuously advance medicine and health care."[3] Students learn to speak the health system's quality improvement language, experience real-world challenges, and show a steady deepening in understanding of health systems improvement over time. These outcomes, which we hypothesize to be a result of integration with clinical skills training, cast an optimistic light on the literature of learner resistance to health systems science. By implementing early hands-on systems learning, future physician attitudes toward health systems improvement may improve.

Next Steps

The future of the CMC includes further integration of clinical skills with systems improvement and an expanded focus on reducing disparities in health and health care. While integration exists, more is possible. Additional refinement of student roles on high-priority health system efforts can deepen alignment of improvement projects with systems resources, a key ingredient for success. Lastly, faculty development in both clinical skills and health systems improvement remains a continual focus, particularly for newer educators.

This single-institution initiative has limitations. We are not aware of a comparable program with this degree of integration of workplace-based health systems and clinical skills training for early students to facilitate outcomes comparison. While CMC students demonstrated the ability to engage with health systems, long-term outcomes are pending. The sustainability of program outcomes requires study over time, and health system stakeholder perspectives are needed for a well-rounded understanding of impact.

In conclusion, the integration of health systems improvement and interprofessional teamwork into clinical skills training has the potential to redefine undergraduate medical education. These lessons learned can inform future efforts to align early medical student education with physician practice.

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A. Chang is professor, Division of Geriatrics, Department of Medicine, University of California, San Francisco, San Francisco, California; ORCID: https://orcid.org/0000-0002-5813-7857.

E. Pierluissi is professor, Division of Hospital Medicine at Zuckerberg San Francisco General, Department of Medicine, University of California, San Francisco, San Francisco, California.

S. Cornes is professor, Department of Neurology, University of California, San Francisco, San Francisco, California.

A. Ishizaki is program manager, Office of Medical Education, University of California, San Francisco, San Francisco, California.

A. Teherani is director of program evaluation and education continuous quality improvement and professor, Department of Medicine, University of California, San Francisco, San Francisco, California.

J.A. Davis is associate dean for curriculum and professor, Department of Medicine, University of California, San Francisco, San Francisco, California.

K.E. Hauer is associate dean for competency assessment and professional standards and professor, Department of Medicine, University of California, San Francisco, San Francisco, California; ORCID: https://orcid.org/0000-0002-8812-4045.

C.R. Lucey is executive vice dean and professor, Department of Medicine, University of California, San Francisco, San Francisco, California.

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