## Supplemental Digital Appendix 1

### The UCSF Clinical Microsystems Clerkship (CMC): Implementation Details

| Domain                          | Resources                                             | Details                                                                                                                                                                                                 |
|---------------------------------|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| **Stakeholder Engagement**      | Design team and curricular team                       | A team of education and clinical leaders developed the vision for the CMC by engaging school and health system stakeholders (e.g., clinical program leaders, quality improvement chiefs, and health policy experts). The team met regularly to refine the vision prior to launch. Since launch, the CMC team has continued regular real-time communication with stakeholders (e.g., annual discussions of health system priorities, invitations to speak at student project presentations) to ensure alignment and reinforce partnerships. |
| **Faculty Development:**        |                                                        |                                                                                                                                                                                                        |
| Clinical Skills                 | Two physician faculty (0.2 FTE each) lead the clinical skills curriculum | CMC clinical skills faculty directors provide standardized written session guides that are the same for all educators regardless of educator medical specialty. Faculty development is conducted in person (e.g., for physical exam technique) and virtually (e.g., for preceptorship logistics) for the community of educators across departments. For specific skills (e.g., the neurologic exam), physician educators from that medical specialty join the coaches’ and students’ learning community as session experts. Faculty development sessions average two hours per month. |
| Health Systems Improvement      | Two physician faculty and three physician site directors (0.2 FTE each) lead the health systems improvement curriculum | CMC health systems improvement faculty directors lead curricular design and student assessment. A physician faculty site director leads the coach community and curricular implementation at each of three health systems. The curriculum directors produce written guides for faculty coaches and interprofessional partners, and the site directors interface with team members on the ground to provide hands-on guidance. Intensive faculty development occurs 1:1 in the six months prior to student matriculation during the project design phase. Educators and students apply the improvement methods used at their health system. Faculty development sessions average two hours per month. |
| Curricular Time                 | The CMC has one full day per instructional week       | The CMC was created as a part of a broader redesign of the entire curriculum for first-year (MS1) and second-year (MS2) medical students. The redesign |
reallocated time away from didactics and towards small group, hands-on and interactive project-based learning. Students spend the same day of the week (Tuesday, Wednesday, or Thursday) in CMC activities each instructional week from matriculation to clerkships.

| Session Example: Clinical Preceptorships | Clinical preceptors include coaches, faculty and community physicians | Students experience three types of clinical preceptorships. 1. Two to three students are scheduled together per coach preceptorship session. 2. One to two students per session are matched with other physician preceptors to broaden their exposure to different clinical practices, and 3. Individual students self-select their own clinical preceptors based on their specific interests. |
| Session Example: Health Systems Improvement | Physician coaches and interprofessional colleagues | Guided by coaches and quality improvement colleagues, student project teams make progress through the Lean A3 steps on a flexible schedule, spending more or less time as needed on each of the seven steps, with particular focus on problem identification, aim statements, and gap analysis as MS1s, and experiments, evaluation, and reflections as MS2s. |
| Administrative Support | The CMC has six full-time staff members | The CMC has one full-time program manager and five additional staff members that partner with the faculty directors to implement and oversee the classroom clinical skills sessions, clinical preceptorship sessions, clinical skills assessments, health systems improvement projects and associated assessments. |

Abbreviations: UCSF, University of California, San Francisco; CMC, Clinical Microsystems Clerkship; MS1, first-year medical students; MS2, second-year medical students.
## UCSF CMC First-Year and Second-Year Medical Student Qualitative Evaluation Data: Single Class In-Depth Analysis; Kirkpatrick Level 1 (Reaction)

| Overall Course Strengths                                                                 | Qualitative Student Evaluation Data (Four Focus Groups; N=41)                                                                 |
|------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Students found CMC highly valuable for their development as physicians.                   | • Students found CMC highly valuable for their development as physicians.                                                    |
| Highlights include time with physicians in clinical settings, the small group learning   | • Highlights include time with physicians in clinical settings, the small group learning community, learning quality          |
| community, learning quality improvement methods, and interactions with patients.          | improvement methods, and interactions with patients.                                                                         |
| Health systems improvement is perceived by students as an essential part of a physician’s| • Health systems improvement is perceived by students as an essential part of a physician’s daily work.                      |
| daily work                                                                                 |                                                                                                                             |

| Areas for Improvement                                                                      |                                                                                                                             |
|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Students recommended consolidating lectures                                                | • Students recommended consolidating lectures                                                                             |
| Students would have liked more patient care experiences                                     | • Students would have liked more patient care experiences                                                                   |
| Some students would like more choice                                                        | • Some students would like more choice                                                                                  |
| Students requested a system to provide early feedback                                        | • Students requested a system to provide early feedback                                                                    |

| Interprofessional Interactions                                                              |                                                                                                                             |
|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Students interacted with interprofessional colleagues and learned the value of teamwork,   | • Students interacted with interprofessional colleagues and learned the value of teamwork, the physician’s role on a     |
| the physician’s role on a team, and workplace professionalism.                              | team, and workplace professionalism.                                                                                       |
| Interprofessional interactions are facilitated by the health systems improvement project,   | • Interprofessional interactions are facilitated by the health systems improvement project, match between clinical       |
| match between clinical workflow and student schedules, and coach guidance.                   | workflow and student schedules, and coach guidance.                                                                       |
| Students were reluctant to “burden” clinicians.                                             | • Students were reluctant to “burden” clinicians.                                                                          |

CMC responses to student input have included decreasing lecture hours each year since launch, increasing hands-on clinical skills sessions, adding self-selected preceptorships and a choice between two well-designed quality improvement projects (where possible), and creating a student and coach outreach system for early feedback.

Abbreviations: UCSF, University of California, San Francisco; CMC, Clinical Microsystems Clerkship;
## Supplemental Digital Appendix 3

**UCSF CMC First-Year and Second-Year Medical Student Sample Health Systems Improvement Projects; Kirkpatrick Level 4 (Results)**

| Project Aim (Fall 2017) | Project Outcome (Fall 2018) |
|-------------------------|-----------------------------|
| **Academic Medical Center** | |
| Primary Care | **Reduce disparities** in hypertension control for Black patients | Increased percentage of patients with at-goal blood pressures by 38% |
| Gynecologic Oncology | **Improve safety** of opiate use after minimally-invasive surgery | Decreased prescriptions for discharge opiates by 30% |
| Neurology | **Improve access** of multiple sclerosis neurogenic bladder treatment | Increased provider knowledge of pelvic floor physical therapy referral to 80% |
| Endocrine Surgery | **Improve experience** of post-surgical discharge process | Increased patient understanding of discharge instructions in 5/5 patients |
| Pediatrics | **Improve experience** by reducing clinic wait times | Decreased average vaccination wait time from 9 to 5 minutes |
| **Public Safety Net Health System** | |
| Psychiatry | **Decrease readmissions** after discharge from inpatient psychiatry | Achieved 64% attendance at first outpatient mental health appointment |
| Obstetrics | **Improve safety** of vaginal and cesarian obstetric hemorrhage | Implemented quantitative blood loss measurement in 84% of deliveries |
| Emergency Department | **Improve quality** in acute stroke treatment with thrombolysis | Achieved goal door-to-needle time of <45 min for 84% of stroke patients |
| Pediatrics | **Improve quality** in management of second-hand smoke for children | Improved smoking cessation intervention implementation rate from 36% to 88% |
| Primary Care | **Improve disparities** in depression screening | Increased screening rate to 63% for non-English speaking and visually-impaired |
| **Veterans Affairs Health Care System** | |
| HIV Clinic | **Improve value** in sexually transmitted disease screening | Achieved 23% reduction in screening tests with no decrease in detection |
| Transgender Clinic | **Improve access** to hormone initiation for transgender veterans | Decreased wait time to hormone therapy from 91 to 30 days |
| Hospital Medicine | **Improve safety** in medication reconciliation at discharge | Improved accuracy of discharge medication reconciliation by 14% |
| Primary Care | **Improve quality** in care of veterans with alcohol use disorder | Increased screening, intervention, and referral rate from 17% to 67% |
| Skilled Nursing | **Improve safety** in diagnosis and treatment of urinary tract infections | Decreased unnecessary urine culture and antibiotic use by 22% |
Supplemental Digital Appendix 4

UCSF CMC Graduating Medical Student Report on Contributions to Professional Development; Kirkpatrick Level 1 (Reaction) and 3 (Behavior)

| Professional Identity:                                                                 | Mean Rating (SD; N=55)\textsuperscript{a} |
|----------------------------------------------------------------------------------------|---------------------------------------------|
| I believe that clinical skills and health systems knowledge are both important to patient experience and clinical outcomes | 4.73 (SD 0.48)                              |
| A physician needs to have both clinical skills and health systems knowledge to be successful | 4.40 (SD 0.63)                              |

| Curriculum Effectiveness:                                                               |                                             |
|----------------------------------------------------------------------------------------|---------------------------------------------|
| The CMC enhanced my understanding of how to improve a health system process of care     | 4.02 (SD 0.95)                              |
| The CMC is an effective integrated way to learn clinical skills and health systems improvement | 3.98 (SD 0.97)                              |
| The CMC added to my understanding of my role as a physician member of the interprofessional team | 3.96 (SD 0.88)                              |

| Career Development:                                                                     | Percentage of Students\textsuperscript{b} |
|----------------------------------------------------------------------------------------|-------------------------------------------|
| I listed my CMC health systems improvement project in my residency application curriculum vitae | 85% Yes (N=44)                             |
| I disseminated my CMC health systems improvement project (e.g., as a local or national poster or oral presentation, or a paper in a journal) | 54% Yes (N=28)                             |
| I discussed my CMC health systems improvement project in my residency personal statement or interview | 31% Yes (N=16)                             |

Summary of MS4 Student Comments:

- Students experienced increased confidence upon entering clerkships due to the early clinical immersion during CMC
- The early workplace learning community is important for clinical skills learning
- Health systems improvement skills are perceived as important in clinical practice but are not emphasized as much as clinical skills during medical school clerkships
- Upon reflection, students reported important learning during CMC in the areas of: interprofessional team communication, patient communication, critical thinking skills, clinical reasoning skills, and health systems improvement.
- Students noted growth in their health systems knowledge and skills, particularly:
  - A realization of deficiencies in current health care systems
  - A sense of urgency for improving patient outcomes
  - The language and tools for health systems improvement
  - The belief that health systems knowledge can improve health disparities

\textsuperscript{a} Scale of 1 (strongly disagree) to 5 (strongly agree). N = graduating students who voluntarily responded to email survey request. All graduating students received the invitation and could complete the sections on professional identity and curriculum effectiveness, even if not proceeding on to residency in 2021.

\textsuperscript{b} Percentage of students in the career development section are calculated based on a lower denominator (N=52) as only students who completed the residency application process in 2021 were invited to complete this section.