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Title

Development of a longitudinal integrated clerkship at an academic medical center.

Permalink

<https://escholarship.org/uc/item/0sw5b9q9>

Journal

Medical education online, 16(1)

ISSN

1087-2981

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Publication Date

2011-04-01

DOI

10.3402/meo.v16i0.5939

Peer reviewed

Development of a longitudinal integrated clerkship at an academic medical center

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In 2005, medical educators at the University of California, San Francisco (UCSF), began developing the Parnassus Integrated Student Clinical Experiences (PISCES) program, a year-long longitudinal integrated clerkship at its academic medical center. The principles guiding this new clerkship were continuity with faculty preceptors, patients, and peers; a developmentally progressive curriculum with an emphasis on interdisciplinary teaching; and exposure to undiagnosed illness in acute and chronic care settings. Innovative elements included quarterly student evaluation sessions with all preceptors together, peer-to-peer evaluation, and oversight advising with an assigned faculty member. PISCES launched with eight medical students for the 2007/2008 academic year and expanded to 15 students for 2008/2009. Compared to UCSF's traditional core clerkships, evaluations from PISCES indicated significantly higher student satisfaction with faculty teaching, formal didactics, direct observation of clinical skills, and feedback. Student performance on discipline-specific examinations and United States Medical Licensing Examination step 2 CK was equivalent to and on standardized patient examinations was slightly superior to that of traditional peers. Participants' career interests ranged from primary care to surgical subspecialties. These results demonstrate that a longitudinal integrated clerkship can be implemented successfully at a tertiary care academic medical center.

Keywords: *education; medical; undergraduate; clinical education; curriculum; continuity; longitudinal integrated clerkship; academic medical center*

Received: 21 December 2010; Revised: 25 February 2011; Accepted: 1 March 2011; Published: 4 April 2011

There are increasing calls for reform of medical education to address the fragmentation of students' experiences in traditional hospital-based block rotations (1, 2). Hirsh and colleagues proposed using continuity as an organizing principle for modern clinical education, emphasizing continuity of curriculum and longitudinal relationships among students, patients, and faculty (2). Several schools have initiated longitudinal integrated clerkships (LICs) during the third year of medical school that emphasize continuity and simultaneous achievement of core competencies for all

major disciplines through continuity with preceptors and a patient panel (3–6).

LICs show promising outcomes. Students in LICs perceived better clinical learning opportunities and access to patients, and were more likely to report longitudinal exposure to disease than students in traditional clerkships (7). Continuity with patients promoted patient-centered attitudes and prevented the erosion of idealism and empathy that occurred among traditional clerkship students (5). Compared to their counterparts in traditional clerkships, LIC students felt more prepared to care for

patients, understand how social context affects patients, and confront ethical dilemmas (5). LIC students were more likely to report receiving feedback and mentoring from supervising faculty than traditional students (5). LIC students' academic performance on written examinations and objective structured clinical examinations was equivalent to or slightly better than the performance of students in a traditional curriculum (5, 8, 9).

LICs have only been implemented in rural or university-affiliated community-based settings. Some were developed with the explicit goals of encouraging primary care or rural medicine careers (4, 8–10). Others, such as the Harvard Medical school/Cambridge Integrated Clerkship, aim to promote foundational professional values and clinical competencies for third-year students regardless of specialty choice (5). To our knowledge, to date no tertiary care academic medical centers (AMCs) have implemented LICs.

Because many medical students are trained in AMCs, new clerkship models should be applicable in these settings. AMCs were originally developed to provide patient care, enable basic and clinical research, and educate trainees (1). Over time, the priorities of AMCs have shifted away from medical education (11). This shift, along with a trend towards greater subspecialization, may impede students' abilities to meet broad core clinical competencies (2). These issues raise the important question of whether an LIC can succeed in an AMC.

The Parnassus Integrated Student Clinical Experiences (PISCES) clerkship is an LIC for third-year medical students at University of California, San Francisco (UCSF), based at a tertiary care AMC composed of both inpatient and ambulatory settings. Two adjoining hospitals are located at the Parnassus campus (Moffitt/Long Hospitals with UCSF Benioff Children's Hospital embedded). Moffitt/Long Hospitals have 660 beds. Three miles from the Parnassus campus is UCSF Mount Zion Medical Center. Mount Zion Hospital has 90 beds. Ambulatory clinics are held in the UCSF Ambulatory Care Center, UCSF Mount Zion Medical Center, and the UCSF Lakeshore Family Medicine Center (three miles away), with a total of 730,000 visits per year. The Emergency Department is located at the Parnassus campus and has 38,000 visits per year. Services at UCSF Parnassus and UCSF Mount Zion range from subspecialties, such as organ transplant, to primary care. There is a separately licensed psychiatric hospital adjacent to Moffitt/Long Hospitals at the Parnassus campus with 67 beds, a partial hospitalization program, and 30,000 outpatient visits per year in a broad range of clinics. This paper describes the development of PISCES with outcome results, and illustrates its unique benefits and challenges. The UCSF Institutional Review Board approved the use of our outcome data for publication.

Planning for the longitudinal integrated clerkship

In 2005 UCSF's curricular leaders charged a task force to envision new models for clinical training, including an LIC. A faculty development group was assembled to design and implement PISCES (Table 1). Each discipline in the traditional third year (family and community medicine, internal medicine, neurology, obstetrics and gynecology, pediatrics, psychiatry, and surgery) allocated 50 per cent of its curricular time for discipline-specific clinical activities. The remaining 50 per cent was allocated for longitudinal patient follow-up with self-directed learning (30 per cent of the total), acute care sessions (10 per cent), and didactic curriculum (10 per cent) (Table 2).

The development year budget was \$70,000, followed by a budget of \$120,000 for PISCES-1 and \$80,000 for PISCES-2. Innovations grants supported development of a comprehensive student assessment program, faculty development program, and integrated case-based curriculum. Each department provided a faculty liaison to PISCES with 5 per cent salary support. A program administrator (30 per cent FTE – full-time equivalent – for the planning period, 75 per cent FTE for PISCES-1, and 50 per cent FTE for PISCES-2 to support the program) created and managed students' clinical and didactic schedules, coordinated with participating departments, and managed the budget. The initial budget supported two co-directors (5 per cent salary support each), and provided modest stipends for PISCES 'stewards' who developed key aspects of the program, such as the patient panel, preceptorships, the curriculum, inpatient experiences, and student and program assessment. The remainder of the budget paid for skills sessions, written exams, pagers, voicemail, computers,

Table 1. PISCES mission statement and core principles

Mission statement

'To educate medical students in an academic setting to practice medicine in a new world that includes evolving healthcare delivery systems, demographic shifts, patient-centered illness models, new health information systems, and changes in graduate medical education.'

Core principles

1. Longitudinal relationships with faculty preceptors and an advisor.
 2. Longitudinal relationships with patients, with an emphasis on patient-centered care.
 3. A developmentally progressive didactic curriculum and clinical skills workshops with an emphasis on interdisciplinary teaching (PISCES school).
 4. Continuity with peers.
 5. Exposure to undiagnosed illness in acute and chronic care settings.
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Table 2. Sample student schedule

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
AM		Medicine clinic	Family and Community Medicine clinic	Psychiatry clinic	Patient panel and self-directed learning*	Surgery (operating room)	Emergency Medicine day call
Lunch							
PM		Urgent Care	Patient panel and self-directed learning*	Pediatrics clinic	Surgery clinic	PISCES school	
Evening		Reflections group					
Time	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
AM		Medicine clinic	Family and Community Medicine clinic	Psychiatry clinic	Gynecology clinic	Anesthesia (operating room)	
Lunch							
PM		Patient panel and self-directed learning*	PISCES school	Patient panel and self-directed learning*	Neurology clinic	Anesthesia (operating room)	
Evening			Emergency Medicine night call				

*Unscheduled time during which the student follows panel patients in the hospital, to outpatient clinic visits, and to consultations, or returns phone calls. The time is also intended for reading and self-directed learning.

and other supplies. Support for the stewards was phased out after PISCES-1. These first three years were supported by a grant from the Drown Foundation through the Haile T. Debas Academy of Medical Educators and the Office of Medical Education.

The PISCES program was launched in April 2007, with eight students in the first year (PISCES-1) as a pilot, and 16 students in the second year (PISCES-2). One PISCES 2 student dropped out of the program after several months for personal reasons and rejoined the program for PISCES-3. Students applied for participation in the program and were selected by lottery. Eighteen students applied for the eight PISCES-1 positions and 16 students for the 16 PISCES-2 positions. All PISCES students had similar baseline academic performance to their peers in traditional clerkships as measured by MCAT (Medical College Admission Test) and USMLE (United States Medical Licensing Examination) step 1 scores (Table 3). PISCES delivers nine core clerkships for 16 students, which is the equivalent of 144 traditional core rotations.

Curricular content for PISCES

Continuity with faculty

Each student was assigned a faculty preceptor for each core discipline, and spent approximately one half-day every one to two weeks with each preceptor. Approximately half of the preceptors were generalists, including most of the internal medicine and all of the family medicine preceptors. Surgery and anesthesiology sessions included outpatient and operating room experiences. Students had four sessions each in ophthalmology, otolaryngology, urology, and orthopedics. The total number of hours for subspecialty teaching were

ophthalmology = 7, otolaryngology = 14.5, urology = 4.5, and orthopedics = 27. If the student was interested, additional hours could be arranged in the operating room or with an individual preceptor. All preceptors were encouraged when possible to reduce their patient load while precepting students. PISCES students typically saw two to four patients per session. Efforts were made to coordinate return patient visits with the same student.

Each student was assigned a PISCES faculty advisor. Advisors met with advisees monthly, including after each quarterly assessment session to discuss feedback from all disciplines, learning goals, and students' patient panels. Advisors referred students to PISCES liaisons for discipline-specific problems or deficits, and assisted with career planning. Advisors were drawn from all core clerkships in the PISCES program. We intentionally did not match advisors with student interests in their respective specialties. Advisors were asked to remain somewhat 'specialty neutral' in their early discussions with their advisees. In the last quarter of the year, advisors discussed possible career interests with their advisees and referred them to the appropriate specialty career advisor.

Continuity with patients: The patient panel

Students developed panels of patients through preceptorships, acute care sessions, and inpatient experiences. Guided by preceptors, advisors, and a list of patient prototypes based on clerkship objectives, students invited patients into their panel, aiming for 50 patients. Except when they had other educational commitments, students were instructed to follow patients into multiple settings, including specialty clinics, labor and delivery, emergency department, operating room, and inpatient wards, and to

Table 3. Demographics and measures of pre- and post-clerkship academic performance for students who participated in PISCES versus traditional clerkship programs in their third year of medical school, 2006–2007 and 2007–2008

	PISCES <i>N</i> = 23	Traditional clerkship <i>N</i> = 206	<i>P</i> -value
Age at time of CPX	28.8 (3.7)	27.7 (2.8)	
Gender (F:M)	9:14	106:100	
Pre-clerkship academic performance variables			
Mean MCAT basic science score \pm SD	12.0 (1.3)	11.7 (1.5)	0.2
Mean MCAT physical science score <i>z</i> score \pm SD	11.9 (1.5)	11.6 (1.8)	0.5
Mean MCAT verbal score \pm SD	10.8 (1.5)	10.5 (1.6)	0.4
Mean USMLE step 1 score \pm SD	227.9 (22.4)	228.9 (21.3)	0.8
Post-clerkship academic performance variables			
Mean composite clerkship evaluation score \pm SD:	3.6 (0.2)	3.6 (.2)	0.3
Mean CPX percentage score \pm SD	67.1 (4.3)	65.6 (4.6)	0.02*
Mean USMLE step 2 CK score \pm SD	231.6 (21.1)	234.5 (22.0)	0.6

*Effect size = 0.02

phone patients when appropriate. The phone calls were overseen by their preceptors. When panel patients were admitted to the hospital, students rounded on the patient daily before or after clinics, informed the inpatient team of relevant outpatient issues, and helped ensure a smooth transition after hospital discharge.

Information technology facilitated students' continuity with patients. Students entered their panel patients in the electronic medical record, which was programmed to inform students of their patients' upcoming appointments for the following day and coming week. The electronic record also initiated student notification via pager each time a panel patient arrived and registered at UCSF. This facilitated unscheduled encounters with panel patients in the emergency department, urgent care clinics, and labor and delivery. Students were expected to keep their pagers on except during vacation and one weekend a month.

Curricular and peer continuity: PISCES school

PISCES students met one afternoon per week for 'PISCES school,' which facilitated continuity with peers. The LIC format provided the opportunity to develop curricular content paralleling the developmental stage of the students. Early sessions targeted clinical skills, in part using simulations, and information useful across disciplines. This included anesthesia simulator sessions using equipment and mannequins that provided instruction on the use of equipment as well as cardio-pulmonary resuscitation and advanced cardiac life support instruction. Traditional lectures were adapted to a case-based format when possible. Unique curricula included 'student report' case presentations, where each student presented a different panel patient six times over the year in a clinical problem-solving format with the student serving as expert for the peers. A faculty facilitator whose clinical experience matched the case topic guided discussion as necessary. Novel cross-disciplinary sessions were developed on multidisciplinary topics, including palliative care, substance abuse, and hospital systems. The latter involved sessions with UCSF hospital administrators and a quality improvement (QI) project. For the QI project, PISCES-1 students worked in groups of four, supervised by a faculty member of the PISCES development group paired with a QI expert, with the goal of addressing a relevant challenge within the hospital system. PISCES-2 students could select to participate in a community-oriented primary care project or a QI project. The projects were formally presented to the PISCES faculty at the end of the year. PISCES school also housed longitudinal reflection sessions, focused on professional identity development, and self- and peer evaluation sessions.

An effort was made to provide the PISCES students with an equivalent structured curriculum compared to

other students. This was done by soliciting the didactic curriculum for each specialty from departmental liaisons. PISCES school time was allocated in proportion to the length of traditional clerkships. In order to fit into these time constraints, the didactic curricula from the specialties were examined for redundancy, eliminated when possible, and integrated where a cross-disciplinary approach might work well (12).

Exposure to acute and inpatient settings

Acute care experiences included 20 emergency medicine half-day sessions, six adult urgent care sessions, 10 pediatric urgent care sessions, and nine full-day emergency medicine weekend sessions. These sessions exposed students to undiagnosed patients and potential panel patients. Students had five weeks of inpatient immersion experiences. One week of inpatient obstetrics early in the year prepared students for subsequent panel patient deliveries. Mid-year, students joined traditional internal medicine ward teams for two weeks as clinical clerks. Later in the year, PISCES-1 students chose one two-week inpatient selective. This option was switched to a two-week surgery inpatient immersion experience for PISCES-2 students and moved earlier in the year.

Interactions with housestaff

PISCES students had fewer interactions with residents than their traditional peers. The students worked with housestaff during their inpatient immersion experiences, similar to a traditional student on a ward team. They also interacted with housestaff when they followed their panel patients into the hospital. In this setting, their role was often similar to that of a primary care physician whose patient is admitted to the hospital. They brought information to the housestaff about the patient, checked in with the housestaff daily about the status of their patient, and facilitated the transition to the outpatient setting when the patient was discharged.

Student assessment

A longitudinal student assessment plan was created for PISCES. Using the ACGME competencies framework (13), the assessment system incorporated formative and summative assessments across disciplines. For formative feedback on patient care skills, students were observed by preceptors in brief structured clinical observations (14, 15). For these, each preceptor observed the student for three minutes during a patient visit approximately once per month. Afterward, the preceptor gave the student three specific feedback points verbally and in writing.

We introduced the RIME (reporter, interpreter, manager, educator) vocabulary and sessions (16). In quarterly evaluation sessions, the seven preceptors for each student discussed the student's clinical and professional development for 20 minutes and constructed an individual

learning plan for the student. Preceptors completed written evaluations of students before each RIME session that contributed to the year-end discipline-specific grades. A student-specific written summary of each RIME session was provided to students and PISCES advisors.

PISCES students completed most of the discipline-specific written examinations administered in traditional clerkships. They also took the comprehensive clinical science examination developed by the National Board of Medical Examiners at the middle and end of the year. Each clerkship director reviewed discipline-specific scores for each student in the integrated exam. The obstetrics and gynecology shelf exam was not given in PISCES-1 but was administered in PISCES-2 to compare with students on the core obstetrics and gynecology rotation who took the exam.

PISCES outcome measures

We sought to answer the following questions about our program.

1. How did PISCES students' perceptions of their clerkships compare to students in traditional clerkships?
2. What were the PISCES students' perceptions of core elements of the program?
3. How did PISCES students' performance on knowledge and skill-based tests compare to students on traditional clerkships?

To answer the questions, we used written surveys and focus groups at the middle and end of the year. One survey asked about PISCES-specific components (patient panel, preceptorships, acute care, and immersion experiences) and another about the overall clerkship experience (achievement of course objectives, direct observation of clinical skills, feedback, overall quality of faculty teaching, overall clerkship experience). Items were on a five-

point scale (1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent). Comparison of traditional and PISCES students' experiences were made using a one-way analysis of variance (ANOVA) with a Bonferroni correction. Effect size was computed using partial eta squared, and effect sizes are listed for significant outcomes. The focus groups probed specific programmatic components (e.g., preceptor-student experiences, patient panels). Two trained research assistants ran the focus groups and coded the data to generate a final list of themes.

PISCES students rated their clerkship experience more favorably than traditional students for all components of the survey; this reached statistical significance for all components except how well they achieved course objectives and their clerkship experience overall (Table 4). Particularly notable differences favoring PISCES were the overall quality of faculty clinical teaching (4.7 versus 4.3), adequacy of direct observation of clinical skills (4.4 versus 3.8), and adequacy of feedback (4.2 versus 3.8), all with P -values of ≤ 0.001 .

In a separate survey on PISCES-specific components (Table 5), the students valued highly their preceptorships (4.52), patient panel experiences (4.22), acute care (emergency 4.83, urgent care 4.57), and inpatient immersion sessions (obstetrics 4.61, internal medicine 4.43). The PISCES student advisors (3.61) and inpatient experiences following their panel patients into the hospital (3.17) received lower ratings.

Focus groups with the PISCES students revealed that the most appealing aspects of the program were the patient panel and the opportunity to work closely with a group of peers. They felt the continuity enabled them to have a very positive impact on their patients' care, and they were able to coordinate different services. Students had concerns about the subspecialized nature of some of their clinics, and challenges developing continuity with patients seen less frequently in these settings. The settings more conducive to recruiting appropriate panel patients were family medicine, internal medicine, obstetrics, and

Table 4. Comparison of PISCES with traditional clerkships, 2007–2009

	PISCES ($N = 23$)		Traditional ($N = 195$)	
	Mean (SD)	Mean (SD)	P -value	Effect size
Year-end evaluations*				
Overall quality of faculty clinical teaching	4.7 (0.4)	4.3 (0.5)	0.000	0.06
Overall quality of resident clinical teaching	4.5 (0.4)	4.2 (0.5)	0.004	0.04
Quality of formal teaching	4.4 (0.4)	4.1 (0.5)	0.009	0.03
Adequacy of direct observation of your clinical skills	4.4 (0.4)	3.8 (0.6)	0.000	0.09
Adequacy of feedback on your performance	4.2 (0.5)	3.8 (0.6)	0.001	0.05
Your achievement of course objectives	4.4 (0.5)	4.3 (0.5)	0.173	–
The clerkship as a whole	4.4 (0.4)	4.2 (0.5)	0.058	–

*Items scored on a five-point scale (1 = poor, 5 = excellent)

Table 5. PISCES program student perceptions

Year-end evaluations: PISCES program years 1 and 2	Mean (SD)
On a scale of 1–5 rate your satisfaction with ...	<i>N</i> = 23
Preceptorships overall	4.52 (0.7)
PISCES advisor program	3.61 (1.0)
Patient cohort experience	4.22 (1.0)
PISCES student case report	4.65 (0.7)
Quality improvement project*	4.05 (0.8)
Emergency room sessions	4.83 (0.4)
Screening and acute care sessions	4.57 (0.7)
Obstetrics inpatient one-week immersion	4.61 (0.7)
Internal medicine inpatient two-week immersion	4.43 (0.8)
PISCES inpatient experience (including admitting patients and rounding)	3.17 (1.2)
PISCES program overall	4.35 (0.9)

**N* = 22

the emergency room. At the end of the program students expressed apprehension about grading, because all grades were assigned at the end of the year. Students also noted difficulty ending patient relationships at the end of the year. Most perceived that traditional clerkship students did not have as much support from peers and faculty and protection from burnout. The students described initially having difficulty learning all the core disciplines simultaneously. Early in the year, the PISCES students felt they were constantly trying to catch up with their traditional peers who had the advantage of immersion experiences in each discipline, but the roles were reversed later in the year. An interview study of PISCES-1 preceptors supports a perception of slower growth of clinical skills early in the year with a rapid advancement of skills across disciplines after five to seven preceptor sessions (17). The preceptors felt their PISCES-1 student gained a higher level of independence than their traditional peers by the end of the year.

We compared traditional clerkship and PISCES students' performances on individual clerkship exams (scale of 0–100 per cent). At the beginning of their fourth year of medical school, all students participated in a high-stakes eight-station clinical performance examination (CPX) which was scored on a 0–100 per cent scale. Performance on the USMLE step 2 examination was also compared. All comparisons of student outcomes were achieved via a one-way ANOVA. There were no statistically significant differences between PISCES and traditional students on the internal medicine, pediatrics, obstetrics and gynecology, or surgery written examinations (Table 6). The latter two are USMLE shelf examinations. There is no written examination in neurology. The family and community medicine final exam is a pass/fail examination. The psychiatry final exam was

Table 6. Written exam scores comparison

		<i>N</i>	Mean (SD)	<i>P</i> -value
Internal medicine	Traditional	171	81.9 (7.9)	0.52
	PISCES	23	83.0 (8.3)	
Obstetrics and gynecology*	Traditional	176	74.2 (7.3)	0.40
	PISCES	15	72.4 (11.9)	
Pediatrics	Traditional	182	87.7 (10.8)	0.38
	PISCES	23	85.7 (11.2)	
Surgery	Traditional	191	73.5 (8.0)	0.93
	PISCES	23	73.3 (9.6)	

*The PISCES-1 students did not take the same exam as traditional students for 2007/2008, so only one year of data are available. Surgery and obstetrics/gynecology used the USMLE shelf exam.

changed to a more challenging exam during the 2008/2009 clerkship year. As a result, the PISCES-1 and PISCES-2 students took different exams, and the traditional students from 2007/2008 and early 2008/2009 took a different exam from late 2008/2009 traditional students. PISCES students had a statistically significant but modestly better overall performance compared to their peers on the CPX at the end of the year: 67.1 per cent correct (SD = 4.3) versus 65.6 per cent (SD = 4.6) respectively, $P < 0.05$. There was no difference between PISCES and traditional students in the mean overall score from faculty evaluations of students; nor was there any difference in the USMLE step 2 CK examination (Table 3). Career interests were diverse and included primary care and specialty fields, similar to their traditional peers.

We conducted a qualitative, semi-structured interview study of PISCES-1 preceptors about their experiences working with students in an LIC, comparing their experiences working in both traditional and PISCES clerkships (17). Of the PISCES-1 preceptors, 57 per cent agreed to be interviewed and represented all the core disciplines. A majority of the preceptors found teaching LIC students to be positive, satisfying, and rewarding. They appreciated watching the students develop over time and felt they personally influenced the students' learning. They noted it took more time with their PISCES student to see patients in the clinical setting than with students on a traditional ward team. In addition, they devoted an additional one to six hours per month to their students to discuss patient care, provide feedback, and answer questions. The time commitment in the clinical setting decreased as the student became more adept, in contrast to a new group of traditional students who needed to be oriented to the clinic or ward service every rotation. The

preceptors also felt they had a higher level of responsibility for their students' learning as their sole preceptor in that discipline.

Discussion

As part of clinical curricular reform at UCSF, the LIC model was implemented as an innovative approach to the increasing challenges of clinical training of medical students. A key element of the LIC model is continuity, proposed as an organizing principle for medical education reform (2, 18) to address the fragmented process of clinical training (19). AMCs potentially have significant barriers to educational continuity, including referral patients with infrequent appointments, underinvestment in ambulatory care, complex information technology infrastructure, departmental boundaries and culture, limited resources to support administrative and faculty teaching efforts, and lack of interdisciplinary teaching models and competency-based evaluation instruments (2). Our student perception and outcome data support the efficacy of the LIC model for core clerkship training in AMCs. Continuity with preceptors, patients, and peers was highly valued by the students. They performed equivalently on discipline-specific examinations and USMLE step 2 CK, and slightly better on standardized clinical examinations compared to traditional clerkship students, consistent with the experience of other LIC programs (5, 8, 9). PISCES is the first LIC successfully implemented in an academic tertiary care medical center, and can serve as a model for educational continuity in this setting.

Success factors for developing and implementing an LIC at our medical center included clear articulation of the limitations of the traditional model, commitment to key principles for clinical training, participation by faculty and clerkship directors from all core clinical clerkships, support from clerkship directors, department chairs, and educational leadership at UCSF, and modest funding to support development, implementation, and management of the pilot program.

Successful implementation of an LIC model should capitalize on strengths of the site and adhere to key features of an LIC. In an academic setting, access to both generalists and subspecialists allows flexibility to redirect clinical experiences over the year to ensure contact with core diagnoses. The complex medical conditions of subspecialized patients are both a resource and a challenge for students in our setting. The relative value of continuity with a preceptor and clinical service versus clinical variety deserves further research in both LIC and traditional models.

The continuity inherent in the LIC model can enhance opportunities for meaningful feedback to students. Traditional clerkship students at UCSF and nationally report that direct observation of clinical skills by supervisors occurs infrequently and feedback on performance is often

inadequate (20). Gil et al. documented that students had a lower perception than faculty of the amount of feedback they received during clinical clerkships (21). Notably, the PISCES students rated observation and feedback significantly higher than their traditional clerkship peers. We believe that, in PISCES, continuity with faculty and use of a structured tool for direct observation and feedback contribute to the enhanced experience with feedback.

There were a number of challenges encountered in our LIC. Preceptor recruitment, support, and development are difficult in any AMC (2), including ours. Concerns about clinical productivity, lack of funding for preceptor teaching, overlap with traditional students, and clinic space constraints are ongoing potential barriers to preceptor recruitment. On the other hand, faculty preceptors were rewarded with meaningful year-long teaching relationships, and participation in a community of teachers committed to longitudinal learning. Unique to our tertiary care setting, half of our faculty were subspecialists, which can limit the breadth of patient types a student sees with their preceptor. This can be mitigated by acute care experiences, discipline-specific call, patient simulation, and 'swaps' between preceptors within a discipline.

There were also challenges for the LIC students. Students in an LIC initially struggle with having to learn multiple disciplines simultaneously. However, compared to their peers, our students achieved equivalent or superior knowledge and clinical skills by the end of the year. Another question is whether this model is optimal for any type of learner, or whether certain students are more likely to thrive in this program. In addition, despite receiving rich and frequent feedback on their performance model, students described progressive anxiety in waiting for grades until the end of the year.

The student advisor program received lower student ratings than other elements of PISCES. Students were uncomfortable having an evaluating preceptor as an advisor, even though the preceptor had the benefit of direct observation of the student's performance. Students also struggled with integrating into the inpatient setting when following their panel patients. We worked with the different specialties to develop guidelines on how PISCES students could interface with the inpatient teams – such as rounding times, faculty and chief resident contacts, and role expectations. In reality, however, teams often varied their daily structure, with new residents rotating from different sites, resulting in unfamiliarity with the PISCES program and how best to integrate the students in this unusual role. Now that the program is more established, faculty and residents are more familiar with it and understand the students' roles and expectations better. Another barrier was the challenge of trying to join rounds and present a patient to the inpatient team the

next day. We attempted to schedule non-clinic mornings after call nights to facilitate the students joining rounds, but this was not consistently possible. However, based on student feedback, we have incorporated more free mornings on post-call days so that students can join the inpatient teams and present their patients.

Doubling the size of the program after its first year was challenging, as it doubled the number of preceptors required, increased the number of PISCES school faculty needed, and increased the necessary administrative support. Traditional third-year clerkship programs continued concurrently with PISCES at all PISCES sites. Transforming these sites completely to the LIC model would require PISCES positions for 60 students. Faculty, clerkship leadership, and department chairs were unwilling to expand the program further in 2008 without evidence of improved learning outcomes. Resources for 60 LIC students including preceptors, teachers, space for five or six PISCES school small groups, and increased administrative support would need to be addressed, although resources currently used for traditional clerkships would shift to an expanded program. PISCES provides the equivalent of 144 core clerkships and decompresses our traditional sites, but the shift in costs is difficult to quantify. The cost of this model compared to traditional clerkships is as yet unknown and merits further investigation.

In parallel to the PISCES program, aspects of the LIC model have been incorporated into a six-month traditional clerkship program for UCSF students at San Francisco General Hospital (25 students) and the San Francisco Veteran's Administration Medical Center (18 students). Further growth of UCSF LIC opportunities have come by partnering with community medical centers. UCSF Fresno launched a six-month LIC for nine students in 2010, and Kaiser Permanente Medical Center in Oakland will launch a one-year LIC program for eight UCSF medical students in 2011. As our curriculum continues to evolve, we hope ultimately to offer clerkship options to all our medical students that incorporate some or all of the key principles underlying the LIC model and leverage the strengths of our individual sites. PISCES is one of the programs participating in a three-school study (Harvard Medical school/Cambridge Integrated Clerkship and Yankton Model Program of the Sanford School of Medicine of the University of South Dakota) funded by the Josiah Macy Foundation to assess the impact of the LIC model on student learning processes and outcomes compared to traditional clerkships.

Conclusion

The development of a longitudinal integrated clerkship based on key principles, including continuity with preceptors, patients, and peers in a developmentally progressive curriculum, was successful at our AMC.

Our experience creating an LIC despite the unique challenges of the AMC environment can serve as a guide for medical educators interested in implementing the LIC model at their own AMC. Additional research to explore the value of the LIC model compared to traditional clerkships is in progress, focusing on patient-centeredness, professional identity development, professionalism, systems-based practice, and patient outcomes. Further studies of how LIC students perform in residency would be useful. A cost-benefit analysis would also be helpful as other institutions consider integrating this model into their curricula.

Practice points

- An LIC can be successful in an academic medical center.
- Key features are longitudinal relationships with faculty, patients, and peers.
- Success involves buy-in from medical school leadership and administrative/IT infrastructure.
- LIC students perform equally to or better than traditional students on knowledge and skill outcomes.
- LIC student perception of observation/feedback is superior to that of traditional students.

Acknowledgements

The authors wish to thank Molly Cooke MD, David Irby PhD, Helen Loeser MD, David Hirsh MD, Barbara Ogur MD, Lori Hansen MD, Bridget O'Brien PhD, Kevin Souza, Danielle Yumol, and Chandler Mayfield.

Conflict of interest and funding

Funding is acknowledged from the Drown Foundation through the Haile T. Debas Academy of Medical Educators, the Office of Medical Education, and the department chairs at the University of California, San Francisco.

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