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SHORT COMMUNICATION



Team-Based Learning in a Longitudinal Integrated Clerkship: an Opportunity for Integrated Multidisciplinary Learning and Curricular Focus on the Underserved

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Abstract

Team-based learning (TBL) offers opportunities to tailor curricula to match specific aims and modalities of innovative medical education models. This paper describes a TBL curriculum developed for a longitudinal integrated clerkship (LIC) at an urban safety-net hospital. Similar to our LIC students' clinical training experience, which includes simultaneously meeting core competencies across specialties in an underserved setting, our TBL curriculum is multidisciplinary and integrates topics related to caring for vulnerable patients. TBL within our LIC avoids the limitations of teaching content in specialty specific silos, creating a cohesive didactic and clinical education model which is highly rated by our students.

Keywords Team-based learning · Longitudinal integrated clerkship · Undergraduate medical education · Curricular innovation

Background

Longitudinal Integrated Clerkships (LICs) are curricular models that provide undergraduate medical students an opportunity to engage in continuity relationships with patients, clinical faculty, and peers and meet core clinical competencies across multiple disciplines simultaneously [1, 2]. LIC students develop a panel of patients with whom they maintain continuity through encounters across specialties and healthcare settings, which promotes student participation in comprehensive and multidisciplinary care of patients over time. Trainees actively learn about health care systems, disease processes, and the illness experience in their clinical assignments [3-6]. The didactic portion of the curriculum is designed to be developmentally progressive, allowing educators to create content that requires more advanced reasoning and knowledge through the course of the clerkship. This acknowledges that students have very different learning needs, knowledge, and skills

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throughout clinical training, in contrast to a block model where the identical content must be repeated rotation after rotation to maintain comparability for students and is not responsive to the developmental stages of learners.

In 2014, the University of Colorado School of Medicine (CUSOM) established the Denver Health LIC (DH-LIC). Denver Health (DH) is an urban, public safety-net hospital with nine integrated federally qualified health centers, providing care to a broad, primarily underserved population [7]. CUSOM students apply to the DH-LIC and 8–10 students are offered positions each year. Students participate in a clinical, experiential, and didactic curriculum focused on care for the underserved, health equity and advocacy. Examples of experiential learning and didactic content in the DH-LIC include sessions on substance use disorders, refugee health care, criminal justice, health literacy, and advocacy. Diverse pedagogic modalities are used in the DH-LIC, including team-based learning.

Team-based learning (TBL) is a student-centered, flipped classroom approach to learning that has become more prevalent in health professions education [8]. It moves beyond acquiring facts towards application and synthesis of information [9]. Unlike the traditional classroom, the TBL model fosters active participation and promotes problem solving and teamwork. A TBL curriculum at the CUSOM in the traditional Internal Medicine (IM) clerkship has been well established since 2012 and served as a model pedagogy for the new DH-LIC.

Although TBL has been used in other integrated courses and LICs have described curricula that include a multidisciplinary case-based approach, we are not aware of any LIC that has adapted the TBL method to complement the unique educational experience of its learners [9, 10]. To more closely mirror our LIC students' clinical training experience simultaneously meeting clinical core competencies across specialties in an underserved setting—we redesigned and built upon the IM clerkship curriculum to create TBL sessions which are multidisciplinary, developmentally progressive, and include themes related to caring for a vulnerable patient population.

Activity

As part of an integrated didactic curriculum, students participate in TBL sessions using cases that focus on common undifferentiated patient presentations. Students complete individual pre-work (e.g., readings pertinent to the case) and an individual readiness assurance test (iRAT). Each 2–3-h TBL session begins with a team readiness assurance test (tRAT) followed by group discussion of questions on the test. Students then participate in 2–3 application exercises (cases) facilitated by faculty content experts. Teams work together to generate differential diagnoses, provide diagnostic work-up, and offer treatment plans. Answers are shared simultaneously, and due to the complexity and ambiguity of the cases, robust discussion is promoted.

Six TBL sessions from the original IM clerkship TBL curriculum were edited to meet the broader LIC curricular goals. Sessions included shortness of breath, chest pain, altered mental status, anemia, respiratory infections, and renal disease. Two new sessions were developed de novo for the DH-LIC: abdominal pain and menopause/bone health. Cases for the DH-LIC curriculum were adapted to be multidisciplinary and focus on care of vulnerable populations. Each TBL session includes cases that depict patients of different ages (child, adolescent, adult, etc.), occur in different care settings (intensive care unit, clinic, emergency department, etc.), include different disciplines (family medicine, pediatrics, OB/GYN, psychiatry, etc.), and highlight themes related to taking care of vulnerable populations (substance use disorders, access to care, homelessness, etc.). Sessions are grouped in a developmentally progressive manner, with cases requiring more advanced clinical reasoning and knowledge later in the year. Table 1 illustrates the current sessions in the DH-LIC TBL curriculum. For example, in the abdominal pain session, prework reading encompasses a book chapter on the surgical approach to evaluating the acute abdomen [11], the HEEADSSS psychosocial interview for adolescents [12], and a fact sheet on consent for minors in the state of Colorado [13]. The first case is an adult with alcohol use disorder who presents with gallstone pancreatitis requiring surgery and anesthesia, the second case is an adolescent with pelvic inflammatory disease cared for in urgent care, and the third case is an adolescent with chronic abdominal pain suffering from toxic stress and chronic mental illness.

Results and Discussion

Eight TBL sessions have been incorporated into the DH-LIC curriculum and are delivered annually. Students complete anonymous, voluntary evaluations that include a 6-point Likert scale (strongly disagree to strongly agree). Tables 2 and 3 demonstrate the numerical data from written evaluations from 2016 to 2019 (n = 26, 100% response rate), which were globally positive. On individual session evaluations, 100% of student participants either agreed or strongly agreed that sessions should be included in future years. On end-of-year course evaluations, most students agreed that TBL was an effective method and increased clinical reasoning skills and understanding of health disparities.

Free-text comments on individual session evaluations repeatedly highlighted that the sessions were "very high yield" and reflected the curricular goals. Students appreciated the diversity of patient types represented in the cases:

I have really enjoyed...sessions in which we have had both adult and pediatric cases - I think this is something special about the LIC...It makes it easier to parse out the differences and learn better how to treat people of different age groups presenting with the same/similar chief complaint.

The integration of underserved themes was also valued:

[The] case was great. [It] included [a] large differential diagnosis...and included social determinants of health which I always appreciate.

A multidisciplinary TBL curriculum with a focus on underserved care reinforces the DH-LIC clinical activities, reflecting the fully integrated approach to medical education that is inherent in LICs. Session organization around presenting symptoms circumvented the limitations of teaching content in specialty-specific silos. This cohesive approach to didactics extended the benefits seen in an LIC model in which students learn clinical care in an integrated format. A critical requirement in the development of clinical reasoning for medical students is the exposure to undifferentiated presentations which allow students to think broadly about differentials and develop skills in prioritizing evaluation and management of patients. This LIC TBL curriculum encourages students to do

Table 1 DH-LIC TBL curriculum

TBL session	Application exercises (cases)	Care setting	Specialty	Patient population	Care for the underserved elements
Abdominal pain	Gallstone pancreatitis	IM hospital ward/OR /surgical ward	IM/surgery	Adult	SUD
	Pelvic inflammatory disease Chronic abdominal pain	Urgent care Clinic	Gynecology Pediatrics	Adolescent Adolescent	Toxic stress, chronic mental illness
Shortness of breath	COPD exacerbation Asthma	Clinic Clinic/ED	Primary care Pediatrics	Adult Child	Environmental safety
Altered mental status	Delirium/dementia Marijuana edible ingestion	IM hospital ward Pediatric ED	IM Pediatrics, EM	Geriatric Child	SUD SUD, environmental safety
Anemia	Acute GI bleed Anemia of chronic disease Iron deficiency anemia	ED/ICU Clinic Clinic	EM/IM/pathology Primary care Pediatrics/pathology	Adult Adult Child	Access to care Lead/environmental
Respiratory infections	Health care associated	ED/ICU	EM/IM	Geriatric	survey
	pneumonia Bronchiolitis Community acquired	Pediatric ward Urgent care	Pediatrics IM/FM/EM	Infant Adult	TB risk,
Menopause and bone health	Menopause Hip fracture	Clinic Clinic	Primary care, OB/GYN Primary care, orthopedics	Adult Geriatric	minigration status
Chest pain	Pericarditis Post-partum pulmonary embolus	ED/ICU Labor and delivery	EM/IM OB-GYN	Adult Pregnant adult	HIV, SUD, homelessness
	Angina/anxiety	Clinic	Primary care, psychiatry	Adult	Poverty, chronic
Renal disease	Hyponatremia	IM hospital ward	IM	Adult	mental niness
	Hematuria Acute kidney injury/rhabdomyolysis	Clinic ED/IM hospital ward	Pediatrics EM/IM	Child Adult	SUD

Key to developmental progression of sessions:

Italics = introductory sessions (early in year)

Bold = intermediate sessions (mid-year)

Bold italics = advanced sessions (late in year)

ED emergency department, *EM* emergency medicine, *ICU* intensive care unit, *IM* internal medicine (inpatient), *FM* family medicine, *primary care* internal medicine and family medicine (outpatient), *OB-GYN* obstetrics and gynecology, *HIV* human immunodeficiency virus, *SUD* substance use disorder, *GI* gastrointestinal, *OR* operating room

Table 2 Individual TBL session evaluation results

TBL session name	The content of the presentation was relevant to my career development	The format of the presentation allowed the speaker to meet their objectives	Overall I was satisfied with the session/presentation	I recommend including this session in the curriculum for the LIC in future years
Abdominal pain	5	5	5	5
Shortness of breath	5	5	5	5
Altered mental status	4.97	4.97	4.97	4.97
Anemia	5	5	5	5
Respiratory infections	5	5	5	5
Menopause and bone health	4.97	5	5	5
Chest pain	4.97	5	5	4.97
Renal disease	4.9	4.9	4.9	4.9

Scores are an average of the evaluations of the past 3 years of TBL sessions (from 2016 to 2019). Students answered on a Likert scale from 0 to 5 (5 being strongly agree)

The TBL curriculum:	2016–2017 (<i>n</i> = 8) (% agree/strongly agree)	2017–2018 (<i>n</i> = 8) (% agree/strongly agree)	2018–2019 (<i>n</i> = 10) (% agree/strongly agree)				
Was an effective strategy to understand the differences in presentation and management of core clinical conditions in patient conditions.	88	100	100				
Increased my understanding of social determinants of health and healthcare disparities.	75	88	80				
Increased my skills in clinical reasoning.	100	100	90				

Table 3 End-of-year TBL evaluation results

this by thinking about illustrative cases of patients presenting at different ages and in different contexts.

The longitudinal aspect of the LIC structure is ideally suited for TBL. Cases are designed to incorporate transitions of care-a key learning objective related to patient safety and one that students experience in their longitudinal clinical experiences, thus providing a space for discussion and exploration of challenges. Additionally, the content itself is progressive in nature as cases become more complex and challenging throughout the year-long course commensurate with students' increasing clinical experience and medical knowledge. Because students experience a stable group of peers and faculty through the year, their learning "team" becomes a safe community for challenging ideas, asking questions, and learning from one another. Finally, curricular space to emphasize themes related to underserved care, a key component of our LIC, is important to equip students with strategies to best serve vulnerable patients. The importance of addressing structural inequality in teaching cases is increasingly recognized, but innovative approaches to teaching medical students about disparities are needed to do this effectively [14]. Furthermore, feeling empowered to assist and advocate for patients is likely to support students in the development of the resilience required for a career serving the underserved [15].

This is a single site innovation that does not include a comparison group. It is unknown if the benefits we see would extend more broadly. Our curricular evaluation is also limited by assessing solely for satisfaction data. Outcomes related to the mastery of content specifically from TBL sessions, separate from the full LIC curriculum or student-specific factors, were not assessed, though DH-LIC students have exceeded CUSOM and national means on objective measures (USMLE step 2 clinical knowledge exam and NBME subject exam scores).

The LIC model has seen rapid expansion worldwide due to the recognized benefits to learners and faculty [16–20]. As a result of the success of existing LIC programs, plans are in place at CUSOM to fully adopt the LIC model for all medical students. Within current and future LICs at the CUSOM, we see TBL as a primary didactic tool to standardize objectives and materials across multiple LIC programs while allowing each unique LIC to develop nuance within cases to fit their own area of curricular focus. Moving towards new models of medical education requires creative thinking about the accompanying didactic components to support curricular structure and goals and maximize learning for emerging physicians. The successful alignment between LICs and TBL with shared emphasis on multidisciplinary patient management, transitions in care, and addressing challenges faced by an underserved patient population allows students to develop high level clinical reasoning whether at the bedside or in the classroom.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval This project was reviewed by the Quality Improvement Committee of Denver Health (QuIRC), which is authorized by the Colorado Multiple Institutional Review Board at the University of Colorado, Denver (COMIRB), and was determined not to be human subject research. As such, this project did not require IRB review.

Informed Consent N/A

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