In 2021, CUSM embarked on a longitudinally integrated curriculum based on the metaphor of climbing a mountain, ascending from the plains to the summit. A guiding principle for the new curriculum is to use evidence-based educational strategies that promote active learning and deeper retention of material. The Hematologic & Lymphatic Systems course occurs during fall of the Plains (first) year, early in students’ medical school journey and is the first systems-based course of their curriculum, covering the hematologic and lymphatic systems. Here, we describe the incorporation and use of team-based learning (TBL) in the “Heme & Lymph” course as a means of achieving these goals and present initial outcome data showing its successful implementation.

### Methods

In order to prepare for TBL, students are assigned `prework`, which consists of brief videos and accompanying materials made by experts on campus. Students are divided into 3 groups (A, B, and C), and each group is assigned prework unique to their group, which allows for a manageable amount of prework (approximately 30 minutes) prior to the TBL event, usually completed on Sundays. On Mondays, students receive lectures on normal physiology, learn about related lab studies and are presented with an algorithm to help them apply this basic information to develop differential diagnoses. Prior to the Tuesday TBL event, students take an individual readiness assessment test (iRAT). At the TBL event, students from each of the 3 prework groups (A, B, and C) are assigned to stable small groups and take the same test together (MAT), this time while sharing information and teaching one another. With this “jigsaw” method, each student brings unique knowledge “pieces” that they share with one another to solve “puzzles,” such as clinical cases. Throughout the event, an audience response system is used to promote discussion. Regardless of which prework group a student is assigned, they are expected to know all material by the end of the week. Thus, on Thursdays, students work through more cases in a small group format with groups led by experts on campus then end the day with an interactive review session to solidify and review real-time feedback on their knowledge and their application. Students then set for their week of end or end of week assessment on Friday. Each week of the course focuses on a theme (week 1), bleeding or clotting problems (week 2), and anemia (week 3). Below are details using week 1 of the course as an example.

**Example prework video discussing Thalassemia**

**Thalassemia - Pathophysiology**

**Anemia Algorithm**

**Team-based Learning Test Results**

**Results**

The course and TBL sessions have been delivered twice. Feedback from students has been positive. Between 67% and 85% of students responded that the TBL sessions were very or extremely effective. Evaluation comments revealed that students enjoyed the active learning from the TBL sessions while also sometimes struggling as the activity pushed them just out of their comfort zone (see selected student comments). Test scores showed an increase from the iRAT (range 48-72% correct), indicating the positive effects of peer teaching (see graph). Students performed well on their end-of-week and end-of-course assessments, made up of board-style clinical vignette questions, with no students failing the course.

**Instructors for students**

- **Team Based Learning (TBL)**
  - Focus on peer learning

- **Sample TBL questions**
  1. Which of the following sets of studies is most consistent with a diagnosis of iron deficiency anemia?

- **Selected Student Comments**
  1. I really enjoyed how much PRACTICE we got. It helped the material stick. I
  2. Learning the diseases via the prework videos and associated materials,
  3. The team-based learning, small group sessions, and facilitated review
  4. The prework and Tuesday TBL were incredibly engaging and a FANTASTIC
  5. I really liked the early on, in person team

**Discussion**

Our findings indicate that TBL is an innovative and practical active teaching method that can be successfully implemented and well received even by very junior medical students. It provides a rich, interactive educational experience in both the large (Anschutz Medical Campus ~160 students) and small (Fort Collins Branch ~20 students) group settings, offering a small group-type experience while not requiring recruitment of large numbers of faculty. TBL can push students out of their comfort zone, which can make them uncomfortable but can also prevent boredom and make them more attentive and engaged with the learning process. The goal is to provide enough challenge but not to make it excessively difficult or cause a loss of engagement, hitting the sweet spot of active learning.

**References**


**with TBL, students can master and apply surprisingly advanced concepts in a relatively brief timeframe. While TBL is challenging for students, requiring self-motivation and application of facts rather than rote memorization, it allows students to see the relevance of the material they are learning and apply it in a meaningful way, to consolidate the information, to identify areas of weakness and misunderstanding and to enjoy problem solving and thinking like a physician.**