



Team-Based Learning in the Surgery Clerkship: Impact on Student Examination Scores, Evaluations, and Perceptions

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OBJECTIVE: There is little evidence for effectiveness of team-based learning (TBL) in specialties such as Surgery. We developed and instituted TBLs in surgery clerkship and compared National Board of Medical Examiners (NBME) Surgery Subject Exam scores before and after implementation. We also analyzed students' feedback for their perception of TBLs.

DESIGN, SETTING, AND PARTICIPANTS: The TBLs were transitioned into the curriculum during the 2013-2014 academic year. The "before" and "after" implementation periods were 2011-2013 and 2014-2016, respectively. NBME Surgery Subject Examination scores at our institution and nationally were compared using the independent samples *t* test. Satisfaction with the clerkship was assessed with Association of American Medical Colleges Graduate Questionnaire data. Student feedback regarding TBL was gathered at the end of each surgery rotation and were analyzed for themes, both positive and negative.

RESULTS: Mean NBME score was higher at our institution than nationally, both before (77.10 ± 8.75 vs. 75.20 ± 8.95 , $p = 0.032$) and after (74.65 ± 8.0 vs. 73.10 ± 8.55 , $p = 0.071$) TBL implementation. The mean score decreased following TBL implementation at our medical school (77.10 ± 8.75 vs. 74.65 ± 8.00 , $p = 0.039$), but it was also lower nationally (75.20 ± 8.95 vs. 73.10 ± 8.55 , $p < 0.001$). Further, students were more likely to rate the surgery clerkship as "good and/or excellent" on the Association of American Medical Colleges Graduate Questionnaire after TBL implementation (84.6% vs.

73.7%). In qualitative assessment, learners stated that TBLs were informative, helpful in studying for the shelf exam, and viewed them as an opportunity for interactive learning, and thus requested more TBLs. Areas for improvement included reading materials, directions, and organization of sessions.

CONCLUSIONS: Student perception of TBL into our surgery clerkship has been both positive and provided feedback for improvement. In addition, our medical school graduates have continued to assess their surgery experience as "good" or "excellent" by a large majority. Concurrently, our NBME scores remain above the national mean. We believe our medical students benefit from a well-organized TBL and its active approach to learning during the surgery clerkship with no loss of fundamental surgery knowledge. (*J Surg Ed* 76:408–413. © 2018 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: Team-based learning, Surgery clerkship, TBL, Surgical education

COMPETENCIES: Medical Knowledge, Professionalism

INTRODUCTION

Team-based learning (TBL) is an instructional strategy that uses small group learning within large classes and promotes active learning.¹ TBL relies on the individual preparation of the student and at least one content-expert instructor to help guide the group and reinforce major concepts.² By shifting the focus from "knowledge transmission to knowledge application" and using individual and group assessment techniques, TBLs have promoted engagement, team dynamics, individual accountability, problem solving,

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communication skills, personal development, and professionalism.^{1,3-8} Since active learning has been shown to be a more powerful learning technique compared to traditional passive learning methods, the Liaison Committee for Medical Education has required that medical education include self-directed learning experiences to develop the skills of lifelong learning in medical students.⁹ Thus, teaching approaches such as TBL have become increasingly prevalent in the world of medical education.

Many studies have evaluated TBL in the preclinical curriculum and suggested that TBL may improve the academic performance and examination scores of students and may also positively impact teachers.^{5,10-16} While active learning in the preclinical years is essential, it may be valuable during the clinical years of medical education, especially in the foundational clerkships such as surgery. The clerkships introduce medical students to the basics of clinical medicine, and from these experiences they start to develop their professional identity as a doctor. However, research regarding the application of TBL in the clinical curriculum, including clinical clerkships, is just emerging for some specialties.^{5,12,13} Previous findings suggest that TBL implementation in some clinical clerkships provides more effective learning and may improve examination scores during clerkships.

However, reports are minimal and limited to non-procedure clerkships, such as pediatrics, psychiatry, and ambulatory medicine.^{4,6,12,17} To our knowledge, TBL has not been implemented and evaluated in subspecialty areas such as surgery to determine if TBL impacts outcomes such as (i) National Board of Medical Examiners (NBME) Subject exam scores and (ii) clerkship evaluations. Further, student perceptions of TBL during clerkships have not been assessed in earlier studies. Thus, the goals of this study were to evaluate the effectiveness of TBL implementation during a surgery clerkship by assessing quantitative scores and qualitative evaluations, feedback, and student perceptions.

METHODS

Student Participants and TBL Structure

During the period of this study the surgery clerkship at our medical school was 1 of the 6 required clerkships in the third year curricula. Each surgery clerkship at our institution is 8 weeks in duration, and there are 6 clerkship rotations in the academic year with approximately 16-18 students per rotation. Our surgery clerkship is comprised of clinical rotations along with required weekly classroom sessions. The surgery clerkship transitioned TBLs into the curriculum during the 2013-2014 academic year. Students were randomly assigned to groups of 4-5 students, and the TBLs were implemented weekly at the classroom sessions. The TBLs

rely on individual preparedness and begin with the individual readiness assessment test (IRAT), followed by the group readiness assessment test (GRAT), and then clinical application facilitated by an expert surgery faculty member.

Students were expected to complete individual preparation prior to the TBL using reading assignments in the *Essentials of General Surgery* textbook by Lawrence et al.¹⁸ The IRAT consisted of 10 multiple choice questions answered individually. Then in the GRAT portion students took the quiz again with their assigned groups. An "IF AT" scratch-off card was used by the group to reveal the correct answer (designated by a star). If the group's first choice was incorrect, students chose again until correct and earned a percentage of full credit. Following the IRAT and GRAT, groups discussed clinical cases and open-ended questions. Finally, the faculty "topic expert" would lead the large-group discussion of GRAT questions and clinical cases, solidifying the importance of critical content. The TBL faculty leader allowed more time for those GRAT questions that a number of teams had difficulty choosing the correct answer.

Data Collection and Analysis

This study was approved by the Institutional Review Board at our institution. Data were retrospectively collected before and after TBL implementation periods. Since the TBL was implemented during the academic year of 2013-2014, we did not consider this transition year in our analysis. Therefore, the before-implementation period was 2011-2013, while the after-implementation period was 2014-2016. The following data were collected:

- 1) NBME Surgery Subject Examination scores. The NBME, which also develops and administers the exams required for medical licensure in the US, the United States Medical Licensing Examination, provides clinical science subject examinations to US medical schools for institutional use. NBME subject examinations assess students' clinical knowledge in the clerkship and provide institutions with useful examinee performance data that can be compared with the national norms.¹⁹ These Subject Exams are calibrated to have a normalized mean and standard deviation of approximately 75 and 8, respectively. Thus, a medical student or a clerkship class with a mean of 83 would be 1 standard deviation above the mean, with a score higher than 84% of other test takers or programs. We collected both national and institutional NBME scores for before and after implementation. The before and after periods were compared using the independent samples *t* test.
- 2) Clerkship evaluation data. Satisfaction with the clerkship was assessed with the Association of

American Medical Colleges (AAMC) Graduate Questionnaire.

- 3) Students' perceptions of TBL. Students' perceptions and feedback regarding TBL were collected at the end of each surgery rotation (6 per year) and were analyzed thematically for both positive and negative themes, using constant comparative method.²⁰

RESULTS

Evaluation of Scores and Clerkship

A total of 208 third-year medical students completed the surgery clerkship during the before (2011-2013) and 199 during the after (2014-2016) TBL implementation periods. There were 107 females (51.4%), with a mean student age of 26.4 ± 2.4 years during the before implementation period. During the after implementation period there were 108 females (54.3%), with a mean student age of 26.6 ± 2.6 years.

The NBME Surgery Subject Exam mean score was higher at our institution than nationally, both before (77.10 ± 8.75 vs. 75.20 ± 8.95 , $p = 0.032$) and after (74.65 ± 8.0 vs. 73.10 ± 8.55 , $p = 0.071$) TBL implementation (Table 1). The NBME Subject Exam mean was lower following TBL implementation at our medical school (77.10 ± 8.75 vs. 74.65 ± 8.00 , $p = 0.039$), but the mean was also lower at the latter period on a national basis (75.20 ± 8.95 vs. 73.10 ± 8.55 , $p < 0.001$). Table 1 shows that medical students were more likely to rate the surgery clerkship good or excellent after TBL implementation (84.6% vs. 73.7%) on the AAMC Graduate Questionnaire.

Student Perception of TBL

The responses and comments from our local survey questions were assessed qualitatively, and both positive and negative themes were identified (Table 2). Overall, students felt that TBLs were educationally effective. They stated that TBLs were *informative* and viewed

them as an *opportunity for interactive learning*. Specific comments included:

"I found the TBLs to be very effective learning opportunities."

"TBLs led to useful discussion for learning."

"Surprisingly, the opportunity to discuss with peers in TBL was one of the most helpful aspects of (surgery) clerkship."

Some students who did not perform well in TBL also found it a useful learning method.

For example, a student stated, "even though I didn't perform the best on the TBLs, it required preparation and enabled discussion of the most essential concepts." Further, many students perceived TBL to be very *helpful in studying for the shelf exam*. They reported:

"TBLs helped with keeping students on task and prepared for shelf."

"TBL was challenging but helpful in preparation for shelf."

"TBLs (were) very helpful for the material that we needed to learn."

Some students also requested more TBLs.

Areas for improvement included providing better *reading materials for TBLs*. Some students did not think that the TBLs and reading material correlated well with the shelf exam and other quizzes. Specific comments were:

"Required textbook correlated poorly with TBL questions."

"The recommended reading from the textbook did not cover the objectives for the TBLs

... I found that when I did not read the textbook and spent my time reading shorter review

TABLE 1. Comparison of NBME Scores and Clerkship Evaluation Before and After TBL

	Before TBL	After TBL	p value
NBME subject exam			
Institution Score (Mean \pm SD)	77.10 ± 8.75	74.65 ± 8.00	0.039
National Score (Mean \pm SD)	75.20 ± 8.95	73.10 ± 8.55	<0.001
p value	0.032	0.071	
Clerkship evaluation on GQ			
% clerkship good/excellent	73.7%	84.6%	NA

GQ = AAMC Graduate Questionnaire.

TABLE 2. Themes Emerging From Qualitative Data With Constant Comparative Method

	Theme	Description
Positive feedback	Educational/informative Great topics and helpful in studying for tests	TBLs were educational, informative, and most useful aspect of clerkship. TBL made students study regularly and at appropriate pace; they were helpful in NBME Subject Exam preparation; and topics were valuable.
	Need more TBLs Interactive learning	More TBLs needed; different topics for TBLs were also suggested. TBL provided opportunity to discuss with peers; led to useful discussion for learning.
Negative feedback	Poor reading material for TBL	Readings for TBL were correlated poorly with TBL quizzes; TBL did not reflect the material on NBME exam.
	Time consuming/too much reading	TBLs discussions were too long; need to be faster and concise; too much reading.
	Minimal learning and poor discussion	In TBLs learning was minimal; discussions led to arguments and not better learning.
	Poor instructions on TBLs and unorganized	Poor communication regarding learning objectives of TBLs.

books, I did better on the TBLs.”

“TBL and quiz questions (were) not reflective of shelf exam.”

Some students also viewed TBL as *more time-consuming* than traditional instruction. For example, one student said, “TBLs . . . helped to expand on the topics they covered; however, they took too long for the little amount of information they covered.” Others felt that TBLs *offered minimal learning and led to poor discussions*. For example, they said:

“TBL learning was rather minimal considering the topics were so broad.”

“Make the TBL lectures and post GRAT session more interactive. I know it is hard to engage so many people at once, but it is doable.”

“TBL tends to create arguments over answers instead of discussions leading to better understanding.”

Further, some felt that the *TBL instructions and organization of sessions* needed some improvements.

DISCUSSION

Team-based learning (TBL) has been examined in the pre-clinical years of medical education, but its use in the clinical years (i.e., during clerkships) is not well studied.

Moreover, to our knowledge, TBL has not been evaluated previously in a surgery clerkship. We reported on TBL in a third-year surgery clerkship along with the perceptions of medical students on their TBL experience.

We found that the mean NBME Surgery Subject Exam score at our institution was higher than the national average, both before and after TBL implementation. While the mean institutional NBME score was lower during the post-TBL period, the mean was also lower nationally during this time. Consequently, TBL may not impact NBME Surgery Subject Exam scores.

The relationship between TBL and NBME Subject Exam scores has varied in other studies. Thomas and Bowen reported better performance for students taught by TBL as compared to those taught by small group lecture in an ambulatory medicine clerkship.¹³ Levine et al. found that implementing TBL in a psychiatry clerkship resulted in significantly higher NBME Subject Examination scores.⁵ In contrast, after initiating TBL, Saudek et al. found no improvement when comparing TBL content with NBME item analysis categories.¹²

Our medical school graduates were more likely to rate the surgery clerkship good or excellent on the AAMC’s Graduate Questionnaire after TBL implementation. While the teaching of attendings, fellows, and residents is a primary factor affecting the educational value of surgical clerkships,²¹ we believe that our TBLs likely influenced the strong evaluations and positive perceptions of the educational experience of our surgery clerks.

Students in prior studies reported that TBL encouraged teamwork and collaboration.^{5-7,17,22} Our students perceived TBL to be educationally effective, informative, helpful for NBME studying, and an opportunity for interactive learning. They also said that our TBLs would benefit from improved organization and instructions. Student feedback indicated that for our TBLs to be successful in a clinical setting, faculty must be highly organized and provide useful resources. Due to initial discomfort with a changing curriculum, students may be uneasy with the adoption of TBL.²³ Therefore, clear communication,

easy-to-follow directions, standard structures, and coherent organization are essential components of implementation.^{24,25} Additionally, the comments from some of our students that TBL provides minimal learning and poor discussion might have been due to the dynamics in some groups. TBL requires extensive group work and interaction in a team setting. With traditional classroom lectures, unprepared students place their individual learning in jeopardy. However, in TBL, group dynamics and team performance, and subsequently learning, suffer when all team members are not prepared and do not contribute to the discussion. Whitley et al. recommended building a diverse team and appropriate faculty involvement during discussions as keys to improving students' perception of TBL.²⁶

While our data were gathered retrospectively, this was not a limitation for our study since NBME Subject Exam scores, Graduate Questionnaire responses, and local student evaluations of TBL were not subject to data accuracy bias. The study was conducted at a single medical school; consequently, the findings should be generalized to other medical schools and clinical settings with caution. Further, while the NBME Subject Examinations correspond well with the curricula of US medical schools, they may not be in accordance as well with curricula of non-US medical schools. However, the NBME and its licensure tests (United States Medical Licensing Examination) and Subject Examinations are internationally recognized as reliable and valid measures of essential knowledge for practicing medicine. The study's 6-year duration allowed for broad participation by faculty and medical students.

In summary, surgery clerkship students may benefit from a well-organized curriculum involving TBL and its active approach to learning with no loss of fundamental surgery knowledge. However, clerkship directors should strive to have TBL cases match the content of the NBME Surgery Subject Examination. Further, faculty development for TBL should focus on clear communication, effective directions, and building diverse teams where all students are encouraged to be well-prepared and active participants in TBL cases.

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