Use of Team-Based Learning Pedagogy for Internal Medicine Ambulatory Resident Teaching

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ABSTRACT

Background Team-based learning (TBL) is used in undergraduate medical education to facilitate higher-order content learning, promote learner engagement and collaboration, and foster positive learner attitudes. There is a paucity of data on the use of TBL in graduate medical education. Our aim was to assess resident engagement, learning, and faculty/resident satisfaction with TBL in internal medicine residency ambulatory education.

Methods Survey and nominal group technique methodologies were used to assess learner engagement and faculty/resident satisfaction. We assessed medical learning using individual (IRAT) and group (GRAT) readiness assurance tests.

Results Residents (N = 111) involved in TBL sessions reported contributing to group discussions and actively discussing the subject material with other residents. Faculty echoed similar responses, and residents and faculty reported a preference for future teaching sessions to be offered using the TBL pedagogy. The average GRAT score was significantly higher than the average IRAT score by 22%. Feedback from our nominal group technique rank ordered the following TBL strengths by both residents and faculty: (1) interactive format, (2) content of sessions, and (3) competitive nature of sessions.

Conclusions We successfully implemented TBL pedagogy in the internal medicine ambulatory residency curriculum, with learning focused on the care of patients in the ambulatory setting. TBL resulted in active resident engagement, facilitated group learning, and increased satisfaction by residents and faculty. To our knowledge this is the first study that implemented a TBL program in an internal medicine residency curriculum.

Introduction

Team-based learning (TBL) was developed to promote active learning, problem solving, and concept application in college classrooms.[1,2] TBL is an active learning strategy that uses a structured combination of presession preparation, an individual readiness assurance test (IRAT), and a group readiness assurance test (GRAT), as well as application exercises to engage learners in their education.[2–4]

TBL has been increasingly used in undergraduate medical education.[5,6] However, there is little data on the use of TBL in graduate medicine education (GME).[7,8] The Accreditation Council for Graduate Medical Education (ACGME) competency of practice-based learning and improvement requires that residents be able to assess their own learning needs and self-improve based on feedback. The ACGME competency of professionalism requires residents to collaborate and work in teams.[9] The TBL pedagogy fosters skills to develop both of these competencies. Residents are required to complete prework, work in teams, and use feedback from peers to self-improve.

In 2012, we substituted our faculty-led, case-based interactive sessions with a TBL pedagogical approach to improve resident participation and learning in the ambulatory setting. This curriculum was designed to evaluate whether TBL resulted in (1) resident/faculty engagement and satisfaction, and (2) resident learning as assessed by multiple readiness assurance tests.

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Editor's Note: The online version of this article contains a list of team-based learning module topics developed for ambulatory curriculum year 1; individual and group readiness assessment tests (IRAT/GRAT); clinical vignettes and learning objectives; a sample of an anonymous survey for peer evaluation and feedback; and comparison of IRAT and GRAT scores for a patient-centered medical home and a hospital-based clinic.

Methods

Setting and Participants

Categorical postgraduate year (PGY)-1 to PGY-3 residents (N = 111) from Hofstra North Shore–LIJ Internal Medicine Residency Program in New York were included in our study. We added TBL to an existing "4 + 1" block schedule,[10] in which residents are divided into 5 cohorts. Each cohort rotated every fifth week for 1 week, in 1 of 2 ambulatory clinics, including a patient-centered medical home and a

hospital-based clinic.[10] Weekly, on average, 12 patient-centered medical home and 8 hospital-based clinic residents were divided into 2 groups at each site (4 to 6 residents per group, total of 4 groups). Groups were permanent, and group assignments were configured to reflect an equal distribution of residents during the 3 years of training. At the beginning of each week, residents were given a TBL orientation.

What was known and gap

Team-based learning (TBL) is known to enhance learning, and promote learner engagement and collaboration, yet there are few studies of its application in resident education.

What is new

An internal medicine program instituted TBL for its 4 + 1 ambulatory rotation curriculum.

Limitations

The single specialty, single program study and lack of a comparison group limit generalizability.

Bottom line

The TBL approach required a small amount of ongoing preparation by facilitators and was preferred by residents and faculty.

Faculty Development

TBL facilitators (n = 15) were full-time faculty in the division of internal medicine, trained for 2 1/2 hours by an internal faculty champion with TBL expertise. We estimated a 0.15 full-time equivalent for each faculty facilitator and a 0.07 full-time equivalent for each faculty champion. All costs were covered by the GME office and the division of general internal medicine. Faculty champions were all ACGME core faculty in the residency program. Training included a brief presentation of TBL history, its use in undergraduate medical education, and a TBL role demonstration. Faculty participated in role playing to practice their responsibilities during the weekly modules.

Program Description

We replaced our faculty-led, case-based, interactive teaching sessions with TBL pedagogy for all ambulatory education. For each academic year, 4 TBL faculty champions prepared 7 distinct TBL modules (provided as online supplemental material) implemented for 5 consecutive weeks, allowing all residents to receive the same module (35 weeks total per year). Compared to the traditional curriculum, we did not change topics, total time allotted, or faculty facilitators. New modules were created each academic year for a total of 21 modules per 3-year curriculum. Faculty champions spent approximately 3 hours preparing each TBL module, while faculty facilitators spent 5 hours per week. We estimated that staff spent 2 hours per module making copies and grading tests. TBL sessions were held weekly for 75 to 90 minutes on 3 consecutive days for the 35-week curriculum. Prior to each TBL week, faculty champions e-mailed residents a recent peer-reviewed article that pertained to that week's ambulatory topic.

On day 1 of the 3-day TBL module, each resident was given a closed-book, 10-question IRAT. The same 10 questions were then administered to the group (GRAT; provided as online supplemental material). For the GRAT, group members discussed each question, agreed on an answer, and held up letters representing the group answer. When teams reported a discrepancy the facilitator provided immediate feedback and reviewed the pertinent points. All tests were collected and scored.

On day 2, residents were given a clinical vignette based on the week's module and 8 preestablished learning objectives. Vignettes and learning objectives were created by faculty champions based on routinely encountered ambulatory topics (provided as online supplemental material). Residents assembled into 2 groups, divided the learning objectives among themselves, and provided 1 additional learning objective per group, totaling 10.

On day 3, residents reported on their assigned learning objectives. One group member summarized their findings while members from the other group added information as needed. The process continued, with faculty switching back and forth between groups until all learning objectives were discussed (TABLE 1).

Peer evaluation and feedback were completed after the final TBL session on day 3. Using an anonymous survey, residents were asked to comment on 1 thing they appreciated and requested of each group member. Faculty provided each resident with a compilation of peer-generated comments for the purposes of self-reflection and improvement (provided as online supplemental material).

Survey Administration

We prepared mandatory, anonymous, 10- and 12-item surveys for faculty and residents, respectively (TABLE 2). A total of 9 of the 12 items were taken from an existing engagement survey.[11] Surveys measured resident involvement, contribution, participation, and engagement, and included comments that were

TABLE 1
Team-Based Learning (TBL) Process

Session	Activity
Pre-TBL session	Residents e-mailed relevant articles and cases
Day 1	Administration of IRAT/GRAT, with faculty facilitating the discussions of the questions
	IRAT/GRAT collected
Day 2	Clinical vignette with 8 learning objectives distributed to residents; faculty facilitates residents' reading of cases and choosing 2 additional learning objectives
Day 3	Residents report out on all learning objectives
Post-TBL session	Residents complete peer evaluations, and peer evaluations are distributed to respective residents

Abbreviations: IRAT, individual readiness assessment test; GRAT, group readiness assessment test.

grouped into themes and analyzed. Surveys were collected weekly and submitted in a sealed envelope.

Nominal Group Technique Administration

At the end of the TBL curriculum, 7 residents (PGY-3) and 10 faculty participated in 2 separate nominal group technique sessions. Residents and faculty provided semiquantitative, rank-ordered feedback on participant perception of our TBL pedagogy. For the nominal groups, we randomly selected 6 to 8 PGY-3 residents who experienced both the traditional ambulatory curriculum and the TBL pedagogy. The nominal group technique included the following: (1) a presentation to the large group with evaluation questions; (2) small group formation to identify strengths/weaknesses; (3) a round robin phase, with the facilitator creating themes from small group comments; (4) a clarification phase; (5) a voting phase; (6) small group data scoring; (7) a combination of large group data; and (8) a wrap-up discussion.[10,12] We specifically asked faculty and residents to comment on the following: "Compared to the traditional

TABLE 2
Engagement Survey Results for Residents and Faculty

Questions[a]	Likert Scale, %									
	Faculty Responses (n = 34)					Resident Responses (n = 258)				
	1	2	3	4	5	1	2	3	4	5
1. Most residents were actively involved in sessions	3	0	3	35	59	0	1	1	43	55
2. I was/residents were mostly passive learners during the sessions	29	47	18	3	3	27	45	18	7	3
3. I/residents contributed meaningfully to group discussions	0	3	6	44	47	0	0	6	54	40
4. I/residents talked with other residents in the sessions about the material	18	15	0	29	38	0	1	4	55	40
5. I was not/residents were not paying attention most of the time in sessions	38	44	6	9	3	56	36	5	1	2
6. I/residents contributed my/their fair share to session discussions	0	0	12	44	44	0	1	6	54	39
7. I/residents paid attention most of the time in sessions	0	0	3	59	38	0	1	3	51	45
8. I/residents participated in the session discussions	ND	0	3	50	47	ND	1	3	53	43
9. I was/residents were mostly active learners in the sessions	ND	0	21	32	47	ND	1	10	52	37
10. I would like more teaching sessions to be like this one	0	35	12	18	35	1	2	11	49	37
11. Faculty member was effective as a facilitator						ND	ND	0	40	60
12. Faculty member assumed a lecture model						14	23	13	28	22

Abbreviation: ND, not done.

[a] All questions started with the statement: Please circle the number under the phrase that best describes the extent to which you agree with the following statements about this week's session. At a 5% level of significance, the responses for faculty were only significantly different from those for the residents for Q4, Q5, and Q10 ($P < .001$, $P = .035$, and $P < .001$, respectively). Faculty surveys consisted of questions 1 to 10, whereas resident surveys included all 12 questions. Likert scale: 1, strongly disagree; 2, disagree; 3, neither agree nor disagree; 4, agree; and 5, strongly agree.

TABLE 3
NGT Data on Strengths and Weaknesses of Team-Based Learning (TBL) Curriculum

Residents (PGY-3)	Faculty
Strengths	
1. Group and interactive format 2. Topic-based approach 3. Dedicated teaching to a topic 4. Reinforces EBM and board preparation 5. Identifies knowledge gaps 6. Competitive environment	1. Interactive and competitive environment 2. Positive morale in educational setting 3. Increased enthusiasm and participation from residents 4. TBL format 5. Topics were covered in-depth
Weaknesses	
1. Time allotted was too short 2. Article selected for preread 3. Content and topic selected 4. Learning objectives 5. Cases selected varied in quality 6. Questions in tests as written 7. Group format (varied participation) 8. Continuity due to "4 + 1" ambulatory schedule	1. Content and topics selected 2. Imbalance of resident participation 3. Individual resident assessment is not realistic

Abbreviations: NGT, nominal group technique; PGY, postgraduate year; EBM, evidence-based medicine.

didactic-based ambulatory learning sessions used last academic year, please comment on the strengths and weaknesses of the TBL curriculum used this academic year."

Our Institutional Review Board declared this study exempt.

Statistical Analysis

Descriptive and summary statistics were calculated for the overall sample and subdivided by site, cohort, PGY, and group. For each TBL module, the nonparametric version of the paired samples *t* test, the Wilcoxon signed rank test for matched pairs, was used to compare IRAT scores to GRAT scores. Comparisons between IRAT and GRAT scores were performed on the combination of both sites, as well as stratified by site. Fisher exact tests were used to compare faculty survey responses from resident responses where appropriate. All analyses were carried out in SAS version 9.3 (IBM Corp).

Results

Comparison of IRAT/GRAT Scores

Among 111 participants, 39 and 72 were from a hospital-based clinic and a patient-centered medical home, respectively (PGY-1, n = 38; PGY-2, n = 36; and PGY-3, n = 37). The average IRAT and GRAT scores for both ambulatory sites were calculated, with an overall composite average IRAT score of 65% and a corresponding GRAT score of 83%. For all modules, the average GRAT score was significantly higher than the average IRAT score, with a range of improvement from 10 to 31 points ($P < .001$ for all modules). When stratified by site, 6 of the 7 modules remained significantly different with higher GRAT than IRAT scores (provided as online supplemental material).

Resident and Faculty Engagement Surveys

Residents and faculty completed an engagement survey at the end of each week. The survey response rates for residents and faculty were 61% and 85%, respectively (TABLE 2). Between 67%–97% of faculty and 89%–98% of residents agreed or strongly agreed that most residents (1) were actively involved in TBL sessions; (2) contributed meaningfully to group discussions; (3) talked with other residents about the session; (4) contributed their fair share to the TBL session; (5) paid attention; (6) participated in session discussions; and (7) were perceived to be learners in the discussion. Themes from both residents and faculty survey comments confirmed that learning and enjoyment were positive aspects of TBL.

Nominal Group Technique Sessions

Strengths and weaknesses of the TBL curriculum were rank-ordered by residents and faculty during the nominal group sessions (TABLE 3). Both reported that the most important strength was the group interactive format and the competition among residents during TBL. Several comments stated that TBL sessions were "educational" and "forced [residents] to learn." Residents and faculty reflected that TBL pedagogy confirmed characteristics of higher-order learning by allowing residents to "ask each other questions," "actively describe [material] to each other," "understand each other's thought processes," and participate in "heated discussions" with "defense of opposing positions."

In terms of negative feedback, several issues were identified, including (1) the imbalance of participation (faculty and residents observed that participation during group discussion was sometimes inconsistent,

with some residents dominating the discussion at times); (2) session time (residents felt that the time allotted for TBL was a weakness); and (3) format (despite the training, facilitators occasionally fell back into "lecture mode," requiring reinforcement of TBL concepts and structure).

Discussion

We successfully implemented TBL pedagogy in a large internal residency program across 2 training sites with a 4 + 1 schedule. Positive feedback from the nominal group technique, for both residents and faculty, supports the premise that learning in teams is favorable and creates an engaging teaching environment. In terms of learning, GRAT scores increased compared to IRAT scores for each module, and the overall composite knowledge scores increased by 22%, as supported by previous research.[8,13] Our results confirmed what is generally found in the literature, which is, as opposed to individual learning, TBL favors group learning and resident engagement, as well as enhances faculty and resident satisfaction in ambulatory education.[14–17]

The nominal group technique was used to assess both faculty and resident satisfaction with the TBL pedagogy as compared to the traditional teaching model. To our knowledge this technique has not been previously used in TBL studies to assess the impact on residency education. Our data demonstrated faculty comfort with assuming the role of a facilitator versus a primary teacher of content. Furthermore, the TBL format allowed faculty to facilitate learning while shifting the teaching responsibility to learners. However, both faculty and residents observed that resident participation during group discussion was sometimes inconsistent, with some residents dominating the discussion while others remained passive. This highlights an opportunity to improve team formation and balance participation within the TBL pedagogy. Future studies should consider involving chief/senior residents in the selection of topics, articles, and cases. Because some residents found that the time allotted for TBL was insufficient, modifications of the usual TBL format and activities may be needed to enhance efficiency.

Our study has several limitations. Its small sample size, single program nature and lack of a comparison limit generalizability. The absence of a formal TBL peer-evaluation process, the fact that only some residents provided feedback, and the 61% response rate to our resident engagement survey introduce the potential for respondent bias. Our study did not measure faculty preparation time and associated costs. We estimate that (1) actual teaching session time was shortened from 5 to 4 1/2 hours, (2) faculty champions incurred 3 hours per module added preparation time, and (3) TBL session facilitators spent 20 minutes preparing prior to each session. Finally, our study did not measure changes to resident behaviors or sustained outcomes. Future studies should assess whether TBL changes resident behavior, affecting improvements in the ACGME competencies of practice-based learning and improvement and professionalism.

Conclusion

We successfully implemented TBL pedagogy in a 4 + 1 schedule at 2 clinic sites. Nearly all residents and most faculty preferred the TBL approach to the traditional ambulatory residency education. The TBL approach required a small amount of ongoing preparation by facilitators provided there are consistent faculty champions.

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