

Feasibility of a Comprehensive Medical Knowledge Curriculum in Internal Medicine Using Team-Based Learning

Gerald Schynoll, MD, MPH, FACP

Elizabeth Irish, MLS, AHIP

Joseph Wayne, MD, MPH, MACP

Raymond Smith, MD, FACP, FIDSA

ABSTRACT

Background Team-based learning (TBL) is an active learning strategy with descriptions of its use in resident education limited to pilot studies.

Objective We developed a comprehensive medical knowledge TBL curriculum for an internal medicine residency, and assessed feasibility.

Methods We developed a 135-topic TBL curriculum to replace a noon conference lecture series, and implemented it over a 3-year period (2013–2016). In this article we describe the planning, curricular design, faculty recruitment and development, and lesson structure. We assessed feasibility in terms of faculty participation, resident preparedness, resident and faculty satisfaction, and costs.

Results Most faculty initially were unfamiliar with TBL. Through faculty resource materials and flexible faculty development, participating faculty increased from 3 to 74. In a 2015 faculty survey (N = 64, 69% response rate), 73% (32 of 44) reported faculty development was adequate, 70% (31 of 44) indicated lesson preparation time reasonable, and 95% (42 of 44) reported preparation materials were helpful. A 2016 resident survey (N = 89, 72% response rate) revealed that most residents completed reading assignments in advance, 78% (50 of 64) found readings manageable, and 77% (49 of 64) felt they learned better from TBL compared to lectures. Costs included compensated time for 1 faculty TBL “champion” and an assistant.

Conclusions Implementing a comprehensive medical knowledge curriculum using TBL in an internal medicine residency was feasible, and resulted in high faculty acceptance and learner satisfaction. Departmental support of a TBL champion, flexible faculty development, and well-designed resource materials were determinants of success.

Introduction

The medical knowledge curriculum is an essential part of residency training and is traditionally taught in a lecture setting,¹ fulfilling the Accreditation Council for Graduate Medical Education mandate for regularly scheduled didactic sessions.² Challenges posed by work hour restrictions, increasing clinical demands, reduced time for teaching, and limited effectiveness of lectures as a means of engaging learners have resulted in calls for active learning approaches.^{3,4} Team-based learning (TBL) is an active learning method that only recently gained traction in graduate medical education (GME).⁵ A growing body of scholarship has demonstrated that TBL promotes learning and teamwork,⁶ learner engagement,⁷

clinical skills development,⁸ and learner and faculty satisfaction.⁹

Team-based learning fosters application of knowledge through individual work, small group work and teamwork, and immediate feedback. Learners acquire knowledge through self-study and completion of required reading assignments. During TBL sessions learners apply this knowledge in a series of problem-solving exercises led by an instructor. This may include Individual Readiness Assurance Tests (IRATs), Group Readiness Assurance Tests (GRATs), and application exercises.^{10,11}

Most reports of TBL in GME have described its use with limited curricular context such as teaching a single skill⁸ or in pilot applications.^{6,9,12} Only 1 report described the replacement of an entire lecture-based curriculum in a physical medicine and rehabilitation residency.¹³ Given the challenges of faculty time commitment and fitting TBL sessions within a busy resident and faculty workday, the feasibility of its adaptation to GME remains unclear.⁵

DOI: <http://dx.doi.org/10.4300/JGME-D-17-00465.1>

Editor's Note: The online version of this article contains the team-based learning (TBL) curriculum, a resident survey instrument, a TBL overview, TBL lesson prep tips, an example of the TBL individual readiness assurance test, an example of a TBL PowerPoint, and tips for facilitators.

We describe the transformation of the curriculum in 1 internal medicine (IM) program to TBL, and discuss the planning, curriculum design, resident orientation, faculty recruitment and development, and lesson structure, and report on program feasibility and sustainability.

Methods

Setting and Participants

Our residency is a medium-sized, university-based program with 48 categorical and 25 preliminary IM residents. We also provide training to 16 medicine-pediatrics residents. Outpatient clinic settings include a Veterans Affairs hospital clinic and a university practice. Prior to 2013 there was a traditional curriculum consisting of noon conference lectures 4 days per week, repeated yearly. Attendance was poor, and residents described the sessions as lacking educational quality. We decided to trial a new TBL curriculum and deliver it within the program's 4+1 block schedule, in which 5 cohorts of 10 residents have 4 weeks of inpatient/elective time followed by an ambulatory week.

Intervention

The transformation to TBL occurred from 2013 through 2016. We designed 2 separate TBL curricula: (1) a weekly hospital and subspecialty TBL lesson taught in a 90-minute noon conference on Fridays for residents on inpatient/elective and ambulatory rotations (the *hospital curriculum*), and (2) an *ambulatory curriculum* with 2 separate, 90-minute TBL lessons taught during a Tuesday morning academic half-day of the ambulatory week, attended by the 10 residents on the ambulatory rotation. The hospital curriculum included 75 topics taught over 18 months repeated once during the 3-year program. The ambulatory curriculum included 60 topics, each taught once during residency. As residents may not take vacation during ambulatory week, attendance was ensured. Topics for both curricula (provided as online supplemental material) were chosen from the table of contents of the Medical Knowledge Self-Assessment Program. We thought this represented the areas of knowledge for competent practice and for residents to pass the American Board of Internal Medicine certification examination. Clinical reasoning, quality and safety, and morbidity and mortality were taught during a traditional 1-hour noon conference Monday to Thursday. One author (G.S.) who had attended the national Team-Based Learning Collaborative meeting assumed the role of TBL "champion."

What was known and gap

Team-based learning (TBL) is an active learning strategy with currently limited application in resident education.

What is new

A 135-topic TBL curriculum in an internal medicine residency, with lessons developed by a sizable cadre of faculty.

Limitations

Single institution study limits generalizability; self-reported outcomes; and surveys without validity evidence.

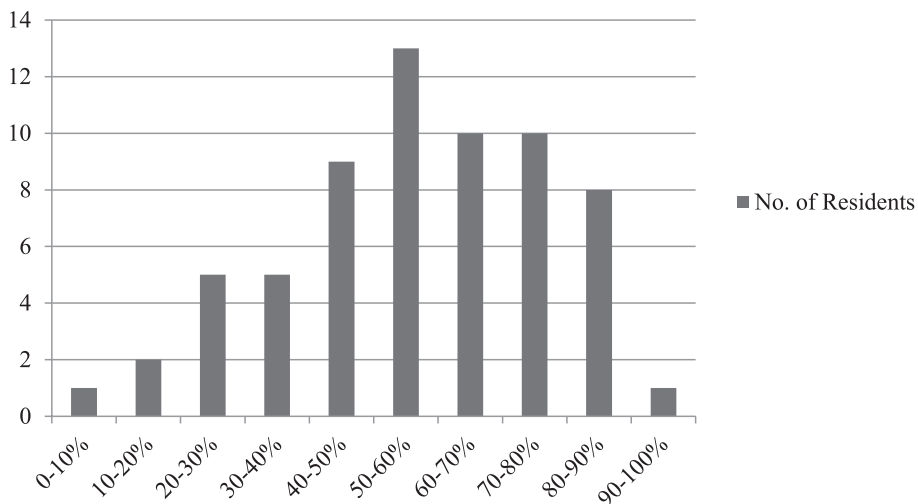
Bottom line

A comprehensive TBL curriculum was feasible in an internal medicine residency, and resulted in faculty acceptance and learner satisfaction.

The authors reviewed background resources on TBL^{10,14–16} and then developed 9 hospital and 2 ambulatory lessons. We chose readings from standard textbooks and journals, and e-mailed them to the residents as attached PDF files. We wrote TBL questions based on content, and modified existing board review questions. Three authors (G.S., J.W., R.S.) served as instructors for the initial sessions.

On July 1 residents received readings for the first hospital topic (pneumonia) and ambulatory topics (gastroesophageal reflux disease and hyperlipidemia). To introduce TBL to the residents, we split the pneumonia lesson into 2 parts. We provided a presentation on TBL methodology, and then administered the pneumonia IRAT and GRAT to 45 residents. The next week we reviewed TBL methodology, and then administered application exercises for pneumonia. Thereafter, we covered an entire lesson in 90 minutes following a standard TBL format (reading, IRAT, GRAT, facilitated discussion, and application exercises with facilitated discussion).¹⁰ We made 8 permanent resident team assignments with an equal distribution of each training year. The ambulatory topics were taught to 10 ambulatory week residents separated into 2 permanent teams according to their clinic assignment. From our initial experience, we determined that covering 5 IRAT/GRAT questions and 5 application exercises in 90 minutes was optimal, and that development of each lesson required 4 to 6 hours.

Faculty recruitment began with support from the department. We invited faculty to attend TBL, and met with interested faculty at division meetings to provide faculty development. Only a few had experience with TBL as learners or instructors, and none had used it in GME. Our faculty development activity was to assign a background TBL reading, and lead the faculty through an IRAT and GRAT with questions pertaining to the TBL method.



FIGURE

Resident Survey: How Often Do You Complete the TBL Readings Ahead of Time? (0%–100%, Round to Nearest 10%)
Abbreviation: TBL, team-based learning.

We captured approximately 30 faculty members in 5 divisions through this activity, and created a number of resources to assist faculty, including (1) TBL method overview; (2) TBL lesson prep tips; (3) example TBL lesson; and (4) facilitator tips (provided as online supplemental material). We selected all readings and created a question bank of existing review questions on each topic for faculty to use to develop IRAT questions and application exercises. Many faculty members received faculty development solely through reviewing these resources and coaching by the TBL champion during lesson delivery. We asked faculty to forward their lesson (1-page IRAT with 5 questions, and PowerPoint with 5 IRAT questions and 5 application exercises each followed by a teaching point slide) to the TBL champion 1 week in advance of each session for quality control of structure and content. No additional administrative time or extra funding was made available to faculty.

The surveys were declared exempt by the Albany Medical College Institutional Review Board.

Outcomes and Analysis

We conducted anonymous surveys of faculty in November 2015 and residents in April 2016 on their experience with the TBL program. We designed the faculty survey and adapted the resident survey from 1 previously published.⁷ We did not test the surveys for validity. We tracked use of resources and expenditures to estimate overall costs. Feasibility was assessed through examination of faculty

participation, resident preparedness, acceptability as reflected in the surveys, and resources required for the program.

Results

By the end of the first year (July 2014), we had recruited 25 faculty for the hospital curriculum, and by July 2015, we had introduced all 75 hospital topics with a faculty of 64 and a lesson every week. By July 2016 we finished recruiting all 10 ambulatory faculty practice physicians, introduced all 60 ambulatory curriculum topics, and had grown the participating faculty to 74. Hospital faculty were repeating topics every 18 months. Ambulatory faculty taught 2 topics per year for 5 consecutive weeks during the academic half-day of the ambulatory week. We stored all lessons in electronic files, and sent them to faculty to modify and update as needed. This decreased preparation time.

The resident survey (64 of 89, 72% response rate) indicated that more than 50% of residents completed the assigned reading ahead of time (FIGURE), and 78% (50 of 64) reported the amount of reading was manageable. Most residents felt that TBL helped them provide more confident patient care (86%, 55 of 64), and that they learned better from TBL than from lectures (77%, 49 of 64; TABLE 1). The faculty survey (44 of 64, 69% response rate) showed that although TBL required added preparation time, 70% (31 of 44) of faculty felt it was manageable. Most felt the preparation materials were helpful (95%, 42 of 44), the faculty development adequate (73%, 32 of 44),

TABLE 1
Resident Team-Based Learning (TBL) Survey^a

Survey Question	Strongly Disagree, No. (%)	Disagree, No. (%)	Neutral, No. (%)	Agree, No. (%)	Strongly Agree, No. (%)
Preassigned readings are manageable	0 (0)	7 (11)	7 (11)	25 (39)	25 (39)
Improves understanding of challenging clinical concepts	0 (0)	0 (0)	2 (3)	23 (36)	38 (59)
Group problem-solving effective way to learn patient care	0 (0)	0 (0)	2 (3)	13 (20)	49 (77)
Team activities solidify knowledge from readings	0 (0)	0 (0)	3 (5)	12 (19)	49 (77)
TBL helps me be more confident caring for patients	0 (0)	1 (2)	8 (13)	25 (39)	30 (47)
I learn better from TBL than lectures	1 (2)	4 (6)	10 (16)	12 (19)	37 (58)

^a N = 89 (64 responders).

and most preferred TBL to lectures (77%, 34 of 44; TABLE 2).

Resources consisted of the efforts of the associate program director, who developed the TBL curriculum in addition to having other responsibilities, and who was supported by an administrative assistant (0.2 full-time equivalent). The 4-month development phase required approximately 16 weekly hours of effort. Current effort for scheduling, updating readings and the question bank, performing quality control, and assisting lesson delivery is 8 weekly hours. Participating faculty spent 4 to 6 hours initially developing a lesson, with less time to update it. Additional costs totaled \$250 for supplies and \$1,500 for textbooks and board review materials. There was no external funding or grant support.

Discussion

We asked faculty to become competent in delivering TBL, although initially most were unfamiliar with this active learning method and had to devote preparation time to lesson development. Their positive reaction (as evidenced by participation and

survey results) may come as a surprise, particularly considering that no additional administrative time or funding was provided. Residents had a similarly positive experience, and showed willingness to prepare by completing advance reading assignments.

Our work builds on previous efforts to implement TBL in GME. Balwan and colleagues⁹ described implementation of a 21-topic ambulatory IM curriculum, with lessons developed by 4 faculty champions and taught by 15 faculty physicians after a training session. Our work shows it is possible to train a larger faculty group to develop lessons themselves, and accept the associated time commitment, allowing for a comprehensive curriculum of 135 topics.

Faculty buy-in is important in successful TBL implementation.¹⁷ Key elements to achieve it included well-designed resource materials, flexible faculty development, and strong guidance from a TBL champion. We showed that TBL can fit within demanding resident and faculty schedules by using an extended 90-minute noon conference and an academic half-day. And though questions have been raised about residents' preparation for active

TABLE 2
Faculty Team-Based Learning (TBL) Survey^a

Survey Question	Strongly Disagree, No. (%)	Disagree, No. (%)	Neutral, No. (%)	Agree, No. (%)	Strongly Agree, No. (%)
Preparation time is reasonable	1 (2)	6 (14)	6 (14)	24 (55)	7 (16)
Preparation materials are helpful	0 (0)	0 (0)	2 (5)	21 (48)	21 (48)
Faculty development is adequate	0 (0)	4 (9)	8 (18)	21 (48)	11 (25)
Residents are engaged	0 (0)	1 (2)	2 (5)	24 (55)	17 (39)
TBL makes topic clinically applicable	0 (0)	0 (0)	6 (14)	16 (36)	22 (50)
I prefer TBL to lecture	1 (2)	1 (2)	8 (18)	14 (32)	20 (45)

^a N = 64 (44 responders).

learning,¹⁸ we showed that a majority completed readings in advance of lessons.

Limitations include implementation in a single IM program, use of surveys without validity evidence, self-reported outcomes, and use of estimates to determine lesson preparation time. Future studies should assess generalizability of broad TBL adaptation in GME, and identify best practices for faculty development and incentivizing residents to prepare through reading.

Conclusion

It is feasible to engage a sizeable faculty group in implementing a comprehensive medical knowledge curriculum within an IM residency, and achieve high faculty acceptance and learner satisfaction. Departmental support of a champion, flexible faculty development, and well-designed resource materials promoting specific lesson structures were important determinants of success.

References

1. Sawatsky AP, Berlacher K, Granieri R. Using an ACTIVE teaching format versus a standard lecture format for increasing resident interaction and knowledge achievement during noon conference: a prospective, controlled study. *BMC Med Educ.* 2014;14:129.
2. Accreditation Council for Graduate Medical Education. Common Program Requirements. https://www.acgme.org/Portals/0/PFAssets/ProgramRequirements/CPRs_2017-07-01.pdf. Accessed December 11, 2017.
3. Lee E, Lazarus ME, El-Farra N. An updated focus on internal medicine resident education. *Am J Med.* 2012;125(11):1140–1143.
4. Cooper AZ, Richards JB. Lectures for adult learners: breaking old habits in graduate medical education. *Am J Med.* 2017;130(3):376–381.
5. Poepelman RS, Liebert CA, Vegas DB, et al. A narrative review and novel framework for application of team-based learning in graduate medical education. *J Grad Med Educ.* 2016;8(4):510–517.
6. Brandler TC, Laser J, Williamson AK, et al. Team-based learning in a pathology residency training program. *Am J Clin Pathol.* 2014;142(1):23–28.
7. McMullen I, Cartledge J, Levine R, et al. Team-based learning for psychiatry residents: a mixed methods study. *BMC Med Educ.* 2013;13:124.
8. Wamsley MA, Julian KA, O'Sullivan P, et al. Team-based learning exercise efficiently teaches brief intervention skills to medicine residents. *Subst Abuse.* 2013;34(4):344–349.
9. Balwan S, Fornari A, DiMarzio P, et al. Use of team-based learning pedagogy for internal medicine ambulatory resident teaching. *J Grad Med Educ.* 2015;7(4):643–648.
10. Parmelee D, Michaelsen LK, Cook S, et al. Team-based learning: a practical guide: AMEE Guide No. 65. *Med Teach.* 2012;34(5):e275–e287.
11. Parmelee DX, Hudes P. Team-based learning: a relevant strategy in health professionals' education. *Med Teach.* 2012;34(5):411–413.
12. McMullen I, Cartledge J, Finch E, et al. How we implemented team-based learning for postgraduate doctors. *Med Teach.* 2014;36(3):191–195.
13. Petty M, Means K. Reinvigorating a residency program through team-based learning: the experience of a physical medicine and rehabilitation program. In: Michaelsen LK, Parmelee DX, McMahan KK, eds. *Team-Based Learning for Health Professions Education: A Guide to Using Small Groups for Improving Learning*. Sterling, VA: Stylus Publishing; 2007:203–213.
14. Michaelsen LK, Parmelee DX, McMahan KK, et al, eds. *Team-Based Learning for Health Professions Education: A Guide to Using Small Groups for Improving Learning*. Sterling, VA: Stylus Publishing; 2007.
15. Parmelee DX, Michaelsen LK. Twelve tips for doing effective team-based learning (TBL). *Med Teach.* 2010;32(2):118–122.
16. Team-Based Learning Collaborative. <http://www.teambasedlearning.org>. Accessed December 11, 2017.
17. Thompson BM, Schneider VF, Haidet P, et al. Factors influencing implementation of team-based learning in health sciences education. *Acad Med.* 2007;82(suppl 10):53–56.
18. Cooper AZ, Hsieh G, Kiss JE, et al. Flipping out: does the flipped classroom learning model work for GME? *J Grad Med Educ.* 2017;9(3):392–393.



All authors are with Albany Medical College. **Gerald Schynoll, MD, MPH, FACP**, is Associate Program Director, Internal Medicine Residency, and Associate Professor of Medicine; **Elizabeth Irish, MLS, AHIP**, is Assistant Professor of Information Sciences, Schaffer Library of Health Sciences; **Joseph Wayne, MD, MPH, MACP**, is Clerkship Director for Internal Medicine, Associate Program Director for Internal Medicine, and Professor of Medicine and Pediatrics; and **Raymond Smith, MD, FACP, FIDSA**, is Program Director, Internal Medicine Residency, and Professor of Medicine.

Funding: The authors report no external funding source for this study.

Conflict of interest: The authors declare they have no competing interests.

The authors would like to thank the residents and faculty at Albany Medical College who participated in and gave their time

to the team-based learning curriculum, as well as Justin Perog for his invaluable administrative support of the project.

Corresponding author: Gerald Schynoll, MD, MPH, FACP, Albany Medical Center, 178 Washington Avenue Extension,

Albany, NY 12203, 518.262.5735, fax 518.262.5743, schynog@mail.amc.edu

Received June 30, 2017; revisions received August 28, 2017, and October 13, 2017; accepted October 20, 2017.