A Narrative Review and Novel Framework for Application of Team-Based Learning in Graduate Medical Education

Rachel Stork Poeppelman, MD
Cara A. Liebert, MD
Daniel Brandt Vegas, MD, FRCPC
Carl A. Germann, MD
Anna Volerman, MD

ABSTRACT

Background Team-based learning (TBL) promotes problem solving and teamwork, and has been applied as an instructional method in undergraduate medical education with purported benefits. Although TBL curricula have been implemented for residents, no published systematic reviews or guidelines exist for the development and use of TBL in graduate medical education (GME).

Objective To review TBL curricula in GME, identify gaps in the literature, and synthesize a framework to guide the development of TBL curricula at the GME level.

Methods We searched PubMed, MEDLINE, and ERIC databases from 1990 to 2014 for relevant articles. References were reviewed to identify additional studies. The inclusion criteria were peer-reviewed publications in English that described TBL curriculum implementation in GME. Data were systematically abstracted and reviewed for consensus. Based on included publications, a 4-element framework—system, residents, significance, and scaffolding—was developed to serve as a step-wise guide to planning a TBL curriculum in GME.

Results Nine publications describing 7 unique TBL curricula in residency met inclusion criteria. Outcomes included feasibility, satisfaction, clinical behavior, teamwork, and knowledge application.

Conclusions TBL appears feasible in the GME environment, with learner reactions ranging from positive to neutral. Gaps in the literature occur within each of the 4 elements of the suggested framework, including: *system*, faculty preparation time and minimum length of effective TBL sessions; *residents*, impact of team heterogeneity and inconsistent attendance; *significance*, comparison to other instructional methods and outcomes measuring knowledge retention, knowledge application, and skill development; and *scaffolding*, factors that influence the completion of preparatory work.

Introduction

The adoption of a competency-based system of evaluation places a greater focus on skill acquisition than prior methods. Graduate medical education (GME) educators must be equipped with efficient and effective instructional methods to develop the necessary knowledge and skills in resident physicians to achieve these competencies.

Team-based learning (TBL) is an instructional method that promotes problem solving and teamwork. TBL exemplifies a flipped classroom: learners acquire knowledge through assigned readings or videos before class, and class time is used to integrate and apply knowledge, building a deeper understanding of concepts.[1] This method has the potential to foster the development of several Accreditation Council for Graduate Medical Education competencies, such as medical knowledge, professionalism, and interpersonal and communication skills.

A TBL session consists of 3 key components: (1) preclass preparation; (2) readiness assurance; and (3) application (FIGURE 1). In preclass preparation (prework), learners review assigned materials before the session to acquire knowledge on a particular topic. The readiness assurance phase begins with a short individual readiness assurance test (IRAT) of multiple-choice questions. Learners then work in teams to complete the same questions, called the group readiness assurance test (GRAT), which is followed by a large group discussion of answers. The application exercise phase presents a real world, complex problem for teams to solve. This exercise mimics the realities of clinical practice, where there is often no single right answer, promoting further discussion within and among teams. These discussions create constructive controversy and encourage peer learning.[1,2] Across multiple TBL sessions, team members remain consistent to foster teamwork and collaboration.[1] Due to the

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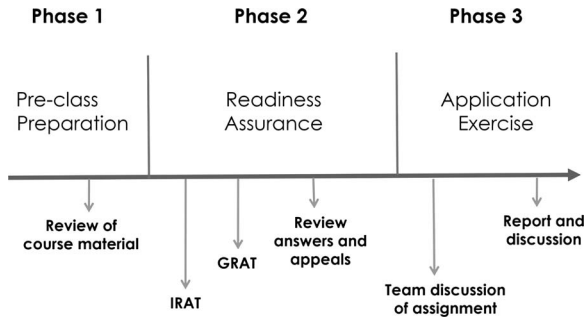

FIGURE 1
Structure of Team-Based Learning Sessions
Note: FIGURE 1 is adapted from Parmelee and Michaelsen.[3] Reproduced with permission.

focus on knowledge application, TBL covers a smaller breadth of material in greater depth.

Most published accounts of TBL in medical education pertain to undergraduate medical education (UME). In comparison with lectures, learning outcomes for UME learners in TBL have been shown to be equivalent or superior.[2] Additionally, UME learners have been reported to prefer TBL over lectures.[4] It has not been established whether these findings in UME will extend to GME.

Descriptions of TBL in GME are beginning to be published. Despite potential benefits of TBL, unique challenges arise in its application in GME. A residency program's protected educational time may lack the flexibility to support the 2- to 3-hour length of traditional TBL sessions. Attendance may be more inconsistent due to off-site rotations, duty hour limits, and unpredictable clinical demands. Instructors also may not be consistent, with different faculty facilitating each session. Additionally, TBL requires preparation by faculty and residents, which may be challenging in the context of clinical demands. Given competing demands on residents' time, specific motivators may be necessary to encourage completion of prework.

To date, no guidelines or reviews regarding the implementation of TBL in GME have been published. This narrative review aims to summarize the existing literature describing the application of TBL in GME and to identify gaps. Using these studies as a foundation, we propose a framework to guide development of TBL curricula for GME.

Methods

We searched PubMed, MEDLINE, and ERIC databases from January 1990 to December 2014 using the keywords *team-based learning*, *graduate medical education*, *residency*, and *residents*. The terms *fellowship* and *fellows* did not identify additional articles. Each article's references were reviewed to identify additional publications.

Studies were included if they were published in English in a peer-reviewed publication and described TBL in GME. Studies were excluded if they did not describe a specific TBL curriculum, were limited to an abstract that lacked the detail necessary to be evaluated using our framework, or described a team-based curriculum that did not follow the TBL model. The full text of articles were reviewed to confirm inclusion.

Two authors (R.S.P. and A.V.) completed a preliminary review of all articles for inclusion criteria. Three authors (C.A.L., R.S.P., A.V.) independently reviewed the full text of included publications to extract data, including details of curriculum planning, curricular structure, learning outcomes, and learner and faculty satisfaction (TABLE). Corresponding authors of the publications were contacted, as needed, to clarify details. Following independent data extraction, the 3 authors reviewed the data for comprehensiveness and consistency. Consensus was reached by discussion.

Development of a TBL Framework for GME

Based on the publications reviewed, we developed a framework for GME educators to provide a road map for the development of future TBL curricula. The framework also provides a stepwise approach to identify and address the unique challenges presented with applying TBL in GME. Based on our review of the included publications, the framework for TBL in GME includes 4 elements: *system*, *residents*, *significance*, and *scaffolding*.

System is the organizational context in which TBL curriculum is developed, and thus directly affects the other steps in the framework. It encompasses faculty leaders, curricular schedule, and institutional support for TBL. Practical considerations in GME include the frequency and length of sessions within clinical obligations, faculty development for TBL, faculty time investment, and facilitator consistency across sessions.

Residents encompasses the learner characteristics and team composition for the planned TBL curriculum. Compared to UME, GME learner groups may be more heterogeneous due to different training levels (postgraduate year [PGY]), distinct medical school experiences, and the variable order of residency rotations and experiences. Although this heterogeneity can improve learning in TBL through knowledge exchange between learners, it needs to be addressed in the planning stage. Learning goals may differ for a group of PGY-1 residents compared with a multilevel

TABLE
Literature Review Examining Articles Based on the Framework for Team-Based Learning (TBL) in Graduate Medical Education

Source, Year, Subject	**System** Setting, Faculty, Institutional Support	**Residents** Learners, Teams	**Significance** Application Exercise, Learner Outcomes	**Scaffolding** Orientation, Prework, Motivators	**Evaluation of Curriculum**
Brandler et al,[5] 2014 Subject: anatomic and clinical pathology	▪ Setting: four 2-h sessions ▪ Faculty: 3 faculty; increased preparation time compared to didactics ▪ Institutional support: literature review and TBL seminar for session faculty	▪ n = 11–16 per session ▪ Learners: PGY-1 through PGY-4 pathology residents ▪ Teams: unspecified size, balanced by training levels	▪ Application exercise: not specified ▪ Learner outcomes: GRAT scores higher than IRAT for each session ($P < .05$); high mean team performance survey scores across sessions (5.3–6 out of 6)	▪ Orientation: not specified ▪ Prework: source reading and learning objectives assigned; most residents completed per facilitator report ▪ Motivators: none specified	▪ Faculty facilitator feedback: "Session was 'alive and engaging'"; "high level of (learner) participation"
Seale et al,[6] 2012, and Shellenberger et al,[7] 2009 Subject: alcohol SBI program	▪ Setting: three 75-min SBI sessions, implemented at 8 programs ▪ Faculty: core faculty traveled to each site to conduct sessions; required 34 h of faculty preparation time (including 9 h of practice) ▪ Institutional support: TBL faculty development program; peer review of TBL materials	▪ n = 175 total, 10–31 per session ▪ Learners: family medicine residents, nurses, triage staff, and faculty ▪ Teams: 4–8 residents	▪ Application exercise: case-oriented group exercises ▪ Learner outcomes: GRAT scores significantly higher than IRAT ($P < .001$); residents' self-reported use of SBI not significantly changed; increased confidence conducting SBI sustained at 12 mo (7.53 to 8.41 out of 10, $P < .001$)	▪ Orientation: not specified ▪ Prework: 3-h NIH-funded SBI program ▪ Motivators: food prizes	▪ Maintained expected attendance of 43%–51% across sessions (based on call schedules) ▪ Residents (75%) preferred TBL to lecture
McMullen et al,[8] 2013, and McMullen et al,[9] 2014 Subject: addictions psychiatry	▪ Setting: eight 2-h sessions ▪ Faculty: different faculty subject expert each week with consistent TBL expert facilitator ▪ Institutional support: TBL conference workshop attended by 2 faculty; TBL 101 workshop for faculty	▪ n = 44 ▪ Learners: PGY-2 psychiatry residents ▪ Teams: 6–7 residents per team	▪ Application exercise: not specified ▪ Learner outcomes: mean prescores and postscores on both subscales of Value of Teams survey unchanged ($P = .52$, $P = .81$); subjective report of improved knowledge and clinical skills on resident survey; online peer evaluation "response rates . . . were very poor"	▪ Orientation: initial 1-h session 2 wk prior; e-mail introduction to TBL ▪ Prework: presession assignment e-mailed week prior; included IRAT (only completed by one-third of participants) ▪ Motivators: book vouchers (highest-scoring team) and iPad (highest-scoring resident)	▪ Significantly higher scores on Classroom Engagement Survey than with didactics ($P < .001$) ▪ Faculty report "high levels of interactivity" ▪ Resident feedback questionnaire (Likert scale and open-ended responses): overall positive responses ▪ Qualitative interviews of residents

TABLE
Literature Review Examining Articles Based on the Framework for Team-Based Learning (TBL) in Graduate Medical Education (continued)

Source, Year, Subject	**System** Setting, Faculty, Institutional Support	**Residents** Learners, Teams	**Significance** Application Exercise, Learner Outcomes	**Scaffolding** Orientation, Prework, Motivators	**Evaluation of Curriculum**
Wamsley et al,[10] 2013 Subject: alcohol SBI program	▪ Setting: single 3-h session; waitlist control study design ▪ Faculty: several expert faculty ▪ Institutional support: not specified	▪ n = 24 (waitlist control group); n = 32 (intervention group) ▪ Learners: PGY-2 and PGY-3 internal medicine residents ▪ Teams: Not specified	▪ Application exercise: role play ▪ Learner outcomes: significantly higher standardized patient brief intervention scores than control ($P < .001$); higher resident self-reported SBI confidence than control ($P \leq .013$)	▪ Orientation: not specified ▪ Prework: narrated PowerPoint, demonstration video, and brief reading ▪ Motivators: none specified	▪ Residents "neutral on whether they would recommend . . . to a colleague"
Touchet and Coon,[11] 2005 Subject: psychodynamic psychotherapy education	▪ Setting: 5-wk segment of psychodynamics course ▪ Faculty: psychiatry faculty ▪ Institutional support: not specified	▪ n = 12–16 ▪ Learners: psychiatry residents of all training levels ▪ Teams: 6–8 members, balanced by training level	▪ Application exercise: not specified ▪ Learner outcomes: subjective faculty report of improvement of resident clinical practice	▪ Orientation: introduction to TBL learning cycle in unspecified manner ▪ Prework: online slide presentations, reading lists, and learning objectives ▪ Motivators: none specified	▪ Resident evaluation scores and comments overwhelmingly positive ▪ Faculty feedback: resident enthusiasm worth the effort
Petty and Means,[12] 2008 Subject: PM&R curriculum	▪ Setting: weekly series over 2-y period (100 lectures) ▪ Faculty: PM&R faculty; subjective report of "significant" preparation time ▪ Institutional support: Office of Educational Development consultation; TBL workshop and retreat for faculty; TBL expert provided feedback/ assistance to faculty	▪ n = 9 ▪ Learners: PGY-2 through PGY-4 PM&R residents ▪ Teams: 2 teams; 2 PM&R-trained international residents split up intentionally	▪ Application exercise: prescription writing exercise ▪ Learner outcomes: written and oral board examination scores and pass rate[a]; in-training examination scores (AAPM&R SAE)[a]	▪ Orientation: educational session about TBL for residents at annual resident retreat ▪ Prework: specific readings already required within curriculum ▪ Motivators: textbook money; subjective report that competition was best incentive	▪ Informal faculty and resident feedback ▪ Lecture attendance statistics[a] ▪ Resident and faculty evaluation scores[a] ▪ Faculty report of improved compliance with assigned readings and attendance at lectures

TABLE
Literature Review Examining Articles Based on the Framework for Team-Based Learning (TBL) in Graduate Medical Education (continued)

Source, Year, Subject	**System** Setting, Faculty, Institutional Support	**Residents** Learners, Teams	**Significance** Application Exercise, Learner Outcomes	**Scaffolding** Orientation, Prework, Motivators	**Evaluation of Curriculum**
Touchet et al,[13] 2013 Subject: evidence-based psychiatry; journal club	▪ Setting: monthly 1-h sessions ▪ Faculty: not specified ▪ Institutional support: not specified	▪ n = 23 ▪ Learners: psychiatry residents of all training levels; key core faculty members ▪ Teams: 5 teams of 4–5 residents and 2 faculty	▪ Application exercise: not specified ▪ Learner outcomes: residents (27%) and faculty (71%) self-report improved critical appraisal skills	▪ Orientation: online documents ▪ Prework: online reading assignments and articles; SharePoint preclass group activity ▪ Motivators: online scoreboard; dinner at program director's home (highest-scoring team)	▪ Faculty and resident participants (73%) preferred TBL to traditional journal club

Abbreviations: SBI, screening and brief intervention; PM&R, physical medicine and rehabilitation; PGY, postgraduate year; GRAT, group readiness assurance test; IRAT, individual readiness assurance test; AAPM&R, American Academy of Physical Medicine and Rehabilitation; SAE, Self-Assessment Examination; NIH, National Institutes of Health.

[a] Data have not yet been published.

group. In addition, when there is disparity among learners, attention must be given to balancing knowledge and experience among teams. Expected attendance may vary and should also be considered in planning the size and number of teams. Once learner characteristics and team composition are defined, the curriculum can be tailored to match learners' needs.

Significance includes the development of goals, objectives, and assessments for a TBL curriculum. Based on formulated goals and objectives, curricular considerations include the type of application exercise and the facilitation of peer feedback. Assessment methods should be considered in parallel with learning goals, with measures aiming to capture the critical thinking and concept application skills central to TBL, rather than simple recall.

Scaffolding refers to structural components essential for a successful TBL curriculum, such as orientation to TBL, prework, and learner motivators. Orientation reduces learner resistance to a new educational approach. Prework provides learners the core knowledge necessary for knowledge application. Because residents have limited free time, the amount of assigned prework is an important consideration, and specific motivators may be necessary to encourage completion of prework, given the usual absence of grades in residency, to motivate learners.

Results

Search Results

The initial literature search yielded 15 articles, of which 8 (53%) met inclusion criteria. A manual search of the reference sections identified 1 book chapter.[12] This review includes 9 publications describing 7 unique TBL curricula (FIGURE 2; TABLE).[5–13]

Study Design and Data Presented

Of the 9 publications included, none employed an experimental design or compared TBL with another instructional method. Only 1 study[10] compared outcomes to a control group, with a nonrandomized waitlist control. Four studies[6–9] reported pretest and posttest data, and 1 study[5] reported posttest data only.

Specialties represented include family medicine,[7] internal medicine,[10] pathology,[5] psychiatry,[8,11,13] and physical medicine and rehabilitation (PM&R).[12] Topics included alcohol screening and brief intervention,[7,10] anatomic and clinical pathology,[5] addictions,[8,9] psychodynamic psychotherapy,[11] evidence-based psychiatry,[11] journal club,[13] and an entire PM&R didactic curriculum.[12] Resident learners ranged from PGY-1 to PGY-4. A subset of curricula

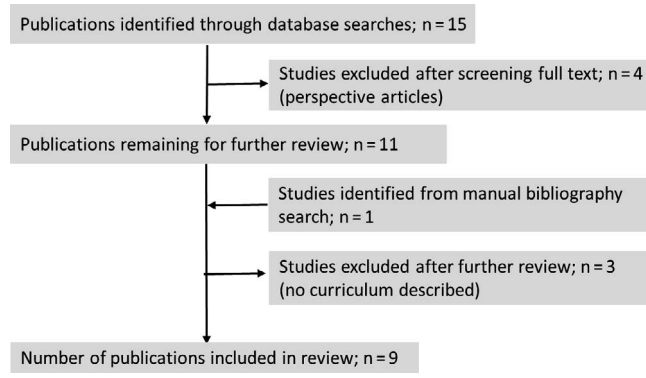

FIGURE 2
Flow Diagram of Selection and Screening Process for Literature Review

also included faculty, nurses, and staff as participants.[7,12,13]

Outcomes measured included performance on a standardized patient assessment,[10] Value of Teams survey,[8,9] team performance survey,[5] self-reported clinical behavior,[6,7] and comparison of IRAT to GRAT scores.[5,7] Three studies[11–13] presented descriptive reports of TBL curricula, with 1 study[12] describing plans to compare outcomes with historical controls in the future.

All curricula assessed learner satisfaction with the curriculum and/or TBL methodology.[5–13] Feasibility data regarding faculty time[5–7,12] and faculty development[5–9,12] were also included in several reports. No studies addressed costs beyond faculty/staff time and training.

Examining Articles Within the TBL Framework for GME

We examined the 7 curricula using the framework we developed for TBL application in GME, summarized findings (TABLE), and used this to identify unanswered questions about TBL in GME.

System: Most curricula consisted of 1 to 8 TBL sessions; however, 1 study[12] described the replacement of an entire 2-year PM&R residency curriculum (100 sessions) with TBL. Experts recommend multiple sessions with consistent teams to yield the communication and team-building benefits of TBL, although no minimum number of sessions has been established.[1] TBL sessions lasted between 1 and 3 hours and replaced didactics or morning report.

In the majority of TBL curricula, faculty development was led by a local "champion,"[9,12] with some faculty also attending national TBL conferences.[8,9] In addition to training facilitators, faculty development increased enthusiasm and buy-in among faculty.[12]

Facilitators varied from a single faculty member to multiple faculty members planning and leading sessions. Measures to ensure consistency and quality among TBL sessions included peer review of materials,[9,12] feedback during practice sessions,[7] and presence of 1 consistent faculty member at all sessions.[9,12]

Notably, articles[5,7,12] described that preparation for TBL sessions required a greater time investment than lectures, with 1 study[7] estimating that 3 TBL sessions required 34 hours of preparation. Faculty subjectively reported that the improved resident enthusiasm was worth this time investment.[7] Objective data describing faculty preparation time are lacking.

Residents: Most curricula included heterogeneous teams of residents at multiple training levels; 1 included only PGY-2 psychiatry residents.[8] Some curricula also included faculty[7,13] and interdisciplinary clinic staff[7] as learners.

Team size ranged from 4 to 8 learners. When specified, team composition was balanced by training level[5,11] and prior knowledge.[8,12] The impact of inconsistent attendance, potentially creating unbalanced teams, on learning and teamwork outcomes is not discussed in the literature.

Significance: TBL curricula primarily used a traditional case-based format for the application exercise.[7,8,11,12] Alternative formats included role play[10] and a research design exercise.[13] These formats align with TBL principles, as they require knowledge application without a single "right" answer.

Peer evaluation included a peer evaluation tool,[5] online peer evaluation,[8] and in-person feedback.[10] The exchange of constructive peer feedback is an integral skill in medical training, and the benefits of including this process in TBL warrant further investigation.

Outcomes of studies largely focused on changes in knowledge, rather than higher-level outcomes of behavior or skill. The sole exception[10] showed significantly higher standardized patient assessment scores for the TBL group compared with a control group. Knowledge gains were demonstrated by significant increases in GRAT scores compared with IRAT scores and resident self-assessment.[7,10,13] No significant change in teamwork outcomes was seen with pre– and post–Value of Teams surveys[8] and team performance surveys.[5] Additionally, most curricula (with 2 exceptions[6,7,12]) measured outcomes only immediately following TBL sessions with no assessment of retention.

Scaffolding: Approaches to orienting learners to TBL included in-person orientations[9,12] and electronic information distribution.[9,13] Studies did not examine the impact of orientation characteristics on learner acceptance of TBL. Varied approaches were used to foster completion of prework by busy residents, often limiting prework to a few articles or online videos. One study[8] considered allotting protected time for prework, but this proved not to be feasible; when the IRAT was included as prework to most efficiently use class time, the completion rate was a disappointing 33%.

Although a range of performance incentives were provided, including food,[7,13] textbook money,[9,11–13] or an iPad,[9] competition was subjectively reported as the most-effective motivator.[7,12]

Learner Reaction

Most learners had positive reactions to TBL as an instructional method and requested more TBL sessions[7,8]; however, a subset of learners felt TBL was less efficient than lectures.[8] One study[10] found residents were neutral about recommending that specific TBL session to colleagues. Informal faculty feedback identified several benefits of TBL: increased learner engagement,[5,8] enthusiasm,[11] and interactivity.[9] This observation is supported by significantly higher scores on a Classroom Engagement Survey for TBL versus didactics.[8]

Discussion

The 7 TBL curricula identified from the literature review provide a foundation for the future study of TBL in GME and are most instructive in regard to feasibility. Learner feedback was largely positive or neutral. Several authors reported increased investment of faculty time in curriculum development in comparison with other instructional methods. The time investment needed to develop TBL curricula is an important feasibility consideration. Most publications included in this review incorporated limited learner assessment and curricular evaluation. Further research with more relevant outcome measures is needed to measure the impact of TBL in GME, in comparison with traditional instructional methods. The studies reviewed do not provide clear evidence of TBL's efficacy in GME. Although some studies showed significant knowledge gains with TBL curricula, future studies should utilize comparison groups or comparison with other instructional methods to study TBL. Given the time investment needed to prepare TBL sessions, it would be useful to identify what topics and learning objectives lead to superior learning outcomes with TBL, rather than with lecture- or small group–based methods, to efficiently utilize program resources.

The majority of significant knowledge outcomes presented showed increases from IRAT to GRAT scores. These readiness assurance tests are completed early in TBL sessions and test the acquisition of background knowledge, not knowledge application. Future work should aim to capture higher-level outcomes than knowledge acquisition, in line with TBL's aim to promote knowledge application. In addition, the GME learning environment presents unique challenges to the use of TBL, and the impact of these challenges on learning outcomes should be explored; these include variable team attendance, heterogeneous teams, session length, variable facilitators, and prework completion motivators.

Limitations of this review include the limited number of included publications, which varied in the level of detail provided, with faculty development, teams, orientation, incentives, and prework often not specified. Most studies had methodological limitations, consisting of observational approaches or a simple posttest design. There do not appear to be published studies of TBL in several specialties, including surgery, emergency medicine, anesthesiology, and pediatrics, and the exclusion of TBL curricula not reported in the literature or missed by our search strategy may have affected the findings. Our framework was developed based on the available descriptions of TBL in GME and may need to be adapted as more is learned about TBL in GME.

Using the framework, we identified areas in need for future study. These include research to determine the minimum length for an effective TBL session in order to address time constraints in GME. Future research should also explore the impact of team heterogeneity in training level and discipline on session development, learning outcomes, and teamwork; develop improved ways for measuring knowledge application and skill development; and measure knowledge retention at longer intervals after TBL. A

final area for study is the impact of different incentives on prework completion and the effect of prework on learning outcomes.

Conclusion

This review identified 7 unique TBL curricula in GME, and proposes a framework for TBL in GME—system, residents, significance, and scaffolding—to guide the development of future curricula. While TBL aims to promote problem solving and deliberate practice of skill-based competencies not easily addressed by didactics—namely communication and teamwork—a limited number of TBL curricula have been described in GME with none specifically designed to address and measure these competencies. The literature shows that TBL can be implemented with residents, although the additional time investment may be considerable and the benefit of this approach for GME learners requires further study.

References

1. 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.
2. Fatmi M, Hartling L, Hillier T, et al. The effectiveness of team-based learning on learning outcomes in health professions education: BEME Guide No. 30. *Med Teach*. 2013;35(12):e1608–e1624.
3. Parmelee DX, Michaelsen LK. Twelve tips for doing effective team-based learning (TBL). *Med Teach*. 2010;32(2):118–122.
4. Levine R, O'Boyle M, Haidet P, et al. Transforming a clinical clerkship with team learning. *Teach Learn Med*. 2004;16(3):270–275.
5. 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.
6. Seale JP, Velasquez MM, Johnson JA, et al. Skills-based residency training in alcohol screening and brief intervention: results from the Georgia-Texas "Improving Brief Intervention" Project. *Subst Abus*. 2012;33(3):261–271.
7. Shellenberger S, Seale JP, Harris DL, et al. Applying team-based learning in primary care residency programs to increase patient alcohol screenings and brief interventions. *Acad Med*. 2009;84(3):340–346.
8. McMullen I, Cartledge J, Levine R, et al. Team-based learning for psychiatry residents: a mixed methods study. *BMC Med Educ*. 2013;13(1):124.
9. McMullen I, Cartledge J, Finch E, et al. How we implemented team-based learning for postgraduate doctors. *Med Teach*. 2014;36(3):191–195.
10. Wamsley MA, Julian KA, O'Sullivan P, et al. Team-based learning exercise efficiently teaches brief intervention skills to medicine residents. *Subst Abus*. 2013;34(4):344–349.
11. Touchet B, Coon K. A pilot use of team-based learning in psychiatry resident psychodynamic psychotherapy education. *Acad Psychiatry*. 2005;29(3):293–296.
12. Petty M, Means K. Reinvigorating a residency program through team-based learning: the experience of a physical medicine and rehabilitation program. In: Michaelsen L, Parmelee D, McMahon KK, et al, eds. *Team-Based Learning for Health Professions Education: A Guide to Using Small Groups for Improving Learning*. Sterling, VA: Stylus Publishing; 2008:203–213.
13. Touchet B, Coon K, Walker A. Journal Club 2.0: Using team-based learning and online collaboration to engage learners. *Acad Psychiatry*. 2013;37(6):442–443.

Rachel Stork Poeppelman, MD, is Pediatrics Resident, Department of Pediatrics, University of Chicago; **Cara A. Liebert, MD,** is General Surgery Resident and Surgical Education Fellow, Division of General Surgery, Department of Surgery, Stanford University School of Medicine; **Daniel Brandt Vegas, MD, FRCPC,** is Assistant Professor, Division of General Internal Medicine, Department of Medicine, McMaster University, Hamilton, Ontario, Canada; **Carl A. Germann, MD,** is Associate Professor, Department of Emergency Medicine, Tufts University School of Medicine and Maine Medical Center; and **Anna Volerman, MD,** is Assistant Professor, Departments of Medicine and Pediatrics, University of Chicago.

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Corresponding author: Rachel Stork Poeppelman, MD, University of Chicago, Department of Pediatrics, Room K155, 5721 S Maryland Avenue, Chicago, IL 60637, 216.280.2360, fax 773.834.0748, rstork@uchicago.edu

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