Team-Based Learning in a Pathology Residency Training Program

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Key Words: Team-based learning; Pathology residency; ACGME

ABSTRACT

Objectives: Team-based learning (TBL) has been integrated into undergraduate and medical education curricula in many institutions. However, TBL has not been widely introduced into postgraduate medical education. Our study aimed to measure the effect of TBL on promoting learning and teamwork in the setting of pathology residency training.

Methods: Four TBL sessions were held and individual and group readiness assurance tests (IRAT/GRATs) were performed; scores were compared using Wilcoxon matched-pairs signed rank tests. Residents completed 18-item validated team performance surveys measuring the quality of team interactions on a scale of 0 (none of the time) to 6 (all of the time). Mean and standard deviation were calculated for each item.

Results: Scores on the IRAT vs GRAT were significantly different ($P < .05$). The team performance survey received mean scores ranging from 5.3 ± 1.1 to 6.0 ± 0.0.

Conclusions: The use of TBL promotes teamwork and learning in a pathology residency program. Residents scored higher on the readiness assurance tests when working in teams, demonstrating the effectiveness of team learning and achievement. In addition, the Accreditation Council for Graduate Medical Education competencies of professionalism and interpersonal and communication skills were further enhanced by incorporating TBL into pathology residency training.

Team-based learning (TBL) has proven to be a valuable tool in undergraduate and graduate medical education curricula in many institutions. In these settings, TBL is replacing the traditional didactic lectures as the preferred educational modality. TBL has been demonstrated to positively influence changes in students’ attitudes about working within teams, in their sense of professional development, and in their comfort and satisfaction with peer evaluation. To date, however, TBL has not been widely introduced into postgraduate medical education.

TBL educational sessions are “learner-centered” as they require the students to complete individual “prework” assignments (eg, reading a book chapter or an evidence-based medicine article) before the session and group assignments during the session (completed with the aid of readily available online resources, eg, PubMed). In this context, the faculty member acts as a facilitator rather than as a “lecturer.” The goals of TBL are two-fold: to deepen students’ learning and to promote development of high-performance learning teams. TBL has a very specific structure, which includes a readiness assurance process followed by application-oriented activities. The readiness assurance process has five vital components: individual study (or prework), individual testing (based on the prework), group testing (identical to the individual test but completed as a team), a written appeal process from teams with questions or arguments that encourage discourse, and lastly, instructor feedback.

Over the past 20 years, TBL has been increasingly used as an active learning strategy. It has been demonstrated that more than 99% of teams taking the readiness assurance test as a group (group readiness assurance test [GRAT]) outperform that group’s best individual member’s test performance.
interesting case presentations offered by the residents. Attending pathologists, as well as journal clubs, seminars, and conferences, need to develop and possess teamwork skills to excel in such an environment.

After completing the group test, the TBL process continues to foster teamwork by requiring the group to defend its answer choices against those of the other groups during the final appeal of the readiness assurance process. Following the readiness assurance process, the groups are able to enhance their cohesiveness as they tackle realistic problems and higher-level questions together. In three studies comparing the use of TBL with traditional lectures in various curricula, students in the TBL curricula performed as well as, or outperformed, those using lecture-based curricula on final examinations or standardized tests. Residents have the potential to achieve a broader knowledge base of evidence-based concepts through TBL, which may help to improve resident in-service and board examination, as well as their eventual individual practice as physicians.

To be effective, TBL assignments should follow the “four Ss:” assignments should be Significant to students, all students should work on the Same problem, students should be required to make a Specific choice, and groups should Simultaneously report their choices. In addition to being a motivational tool for undergraduate and medical school learning and a developmental tool for teamwork, TBL can be a valuable component of postgraduate training. In our study we aimed to measure the effect of TBL on promoting learning and teamwork in the setting of an anatomic and clinical pathology residency training program.

Materials and Methods

Sample
The study participants consisted of 11 to 16 pathology residents in postgraduate years 1 through 4 at North Shore-LIJ (NSLIJ) Health System, Lake Success, NY. The local institutional review board approved an exemption for this study.

TBL Sessions
As part of the pathology residency curriculum at NSLIJ, residents attend 1-hour didactic sessions every morning. These sessions span anatomic and clinical pathology disciplines, and include lectures and slide seminars given by attending pathologists, as well as journal clubs, seminars, and interesting case presentations offered by the residents.

In place of four of these “usual” didactic sessions, four 2-hour TBL sessions were held on different days, facilitated by different attending pathologists. The faculty pathologists underwent prior training in TBL by reading books and articles and attending a seminar on TBL. Topics included molecular diagnostics in lung cancer (facilitated by a molecular pathologist), interstitial lung disease (facilitated by a thoracic pathologist), death certification (facilitated by a forensic pathologist), and delayed hemolytic transfusion reactions (facilitated by the director of transfusion medicine). Residents were assigned source reading to be completed before the session, as well as learning objectives, to acquire basic knowledge of the topic. This preparatory reading replaced the usual lecture-style presentation of basic information. Teams of first- through fourth-year residents were assembled to achieve balance among various training levels. To reinforce foundational concepts and to measure whether the fundamental concepts were internalized, participants took the IRAT and GRAT, which consisted of questions based on the preparatory material Table 1, which were followed by application-oriented activities Figure 1. The application exercises consisted of more complex problem solving, built on the foundational knowledge gained in preparation, and reinforced during the group test, during which the residents demonstrated critical thinking skills and problem-solving strategies in real-life pathology examples.

Measurements and Data Analysis

The results of the IRAT and GRAT performed during each TBL session were compared using Wilcoxon matched-pairs signed rank tests. Nonparametric tests were used because of lack of normal values.

A peer evaluation tool to assess team performance was used in the first session, but it was decided to replace this assessment with a more structured, validated survey tool in the subsequent sessions. After three of the four TBL sessions, the participants completed an 18-item validated and reliable team performance survey which measured the quality of team interactions on a scale of 0 (none of the time) to 6 (all of the time). Mean and standard deviation were calculated for each item in this survey.

All statistical analyses were performed using STATA 10.1 (StataCorp, College Station, TX).

Results

Scores on the IRAT vs GRAT were significantly different, with P < .05 for the first through fourth TBL sessions Table 2. The team performance survey received mean scores ranging from 5.3 ± 0.9 to 6.0 ± 0.0 Table 3.
B. According to ASCO, anti-EGFR therapies can be used as first-line therapies for disease with EGFR mutations.

A. According to ASCO, anti-EGFR antibodies should be given to patients with EGFR mutations.

C. EGFR TKD alterations

D. EGFR vIII

E. EGFR mutation specific antibodies

2. EGFR and demographics: Which of the following statements is correct?

A. EGFR mutations are associated with "never smokers" and with Asian men.

B. EGFR mutations are exclusively found in pure adenocarcinomas.

C. EGFR mutations are associated with Asian men.

D. EGFR mutations are more associated with adenocarcinoma, solid type, rather than lepidic growth pattern.

E. EGFR mutation specific antibodies

3. EGFR and methodology: Which of the following tests are most appropriate for EGFR testing in NSCLC-adenocarcinoma?

A. Total EGFR

B. EGFR copy number alterations

C. EGFR TKD alterations

D. EGFR vIII

E. EGFR mutation specific antibodies

4. EGFR and patient management/treatment: Which of the following combination is seen in UIP?

A. Upper lobe nodules/necrotizing bronchiolocentric granulomas.

B. Bibasilar fibrosis/patchy organizing fibrosis.

C. Bilateral ground glass opacities/

D. Bibasilar fibrosis/microscopic honeycombing.

E. DIP

5. EGFR and histologic findings of chronic interstitial pneumonia, focal intra-alveolar fibroblastic proliferation, and rare bronchiolocentric, poorly formed granulomas. The best diagnosis is:

A. COP

B. AFOP

C. CHP

D. CAP

E. DIP

6. A patient presents with progressive shortness of breath, bilateral ground glass opacities, and histologic findings of chronic interstitial pneumonia, focal intra-alveolar fibroblastic proliferation, and rare bronchiolocentric, poorly formed granulomas. The best diagnosis is:

A. COP

B. AFOP

C. CHP

D. CAP

E. DIP

7. Antibodies directed against which of the following blood group systems are most commonly implicated in intravascular hemolytic transfusion reactions?

A. ABO

B. Kidd

C. Rh

D. Duffy

E. ABO AND Kidd

8. Risk factors for higher rate of alloimmunization include all except:

A. Age

B. Gender

C. Rh

D. Duffy

E. Ethnic diversity between blood donors and patients

9. Which of the following combination is seen in UIP?

A. Bilateral ground glass opacities/microscopic honeycombing.

B. Bibasilar fibrosis/patchy organizing pneumonia.

C. Prewarm technique to eliminate interfering cold antibodies.

D. Eluate despite negative DAT

E. Increasing serum-to-cell ratio in reaction tube

AFOP, acute fibrinous organizing pneumonia; ASCO, American Society of Clinical Oncology; COP, chronic aspiration pneumonia; CHP, chronic hypersensitivity pneumonitis; COP, cryptogenic organizing pneumonia; DAT, direct antiglobulin test; DC, death certificates; DIP, desquamative interstitial pneumonia; EGFR, epidermal growth factor receptor; GRAT, group readiness assurance test; HRCT, high-resolution computed tomography; IRAT, individual readiness assurance test; NCCN, National Comprehensive Cancer Network; NSCLC, non–small cell lung carcinoma; TBL, team-based learning; TKD, total kidney disease; UIP, usual interstitial pneumonia.
training program. Our results corroborate those of previous
the setting of an anatomic and clinical pathology residency

effectiveness of TBL in promoting learning and teamwork in
is perceived in a favorable manner by the participants.

that the group learning experience

internalized in the group setting. The team performance sur-

GRAT scores demonstrates that resident learning is further

to achieve the best answer. The difference between IRAT and

complicated and difficult application problems subsequent
to the IRAT and GRAT assessments. Although the GRAT

includes the same questions as the IRAT; the importance of
the GRAT is not only the teamwork achieved by answering
questions together, but also the beginning of residents teach-
ing their peers and the group discussing each question together
to achieve the best answer. The difference between IRAT and

P values were determined using Wilcoxon matched-pairs signed rank tests for all of
the IRAT and GRAT test scores.

Table 2
Comparison of IRAT and GRAT Test Scores

<table>
<thead>
<tr>
<th>Session No.</th>
<th>Mean (SD) IRAT</th>
<th>Mean (SD) GRAT</th>
<th>P Valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>55.7 (0.17)</td>
<td>92.8 (0.04)</td>
<td>.001</td>
</tr>
<tr>
<td>2</td>
<td>41.3 (0.21)</td>
<td>97 (0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>3</td>
<td>79.2 (0.19)</td>
<td>100 (0)</td>
<td>.003</td>
</tr>
<tr>
<td>4</td>
<td>50 (0.2)</td>
<td>88.8 (0.02)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

GRAT, group readiness assurance test; IRAT, individual readiness assurance test.

Discussion

Using TBL, residents were able to solve complex problems and work through difficult scenarios in a team setting. The faculty members observed the use of critical thinking skills and problem solving during the group application exercises. This study provides evidence that the use of TBL in a combined anatomic and clinical pathology curriculum enhances resident education by promoting and developing teamwork among residents as well as by increasing resident engagement. Importantly, the usual “lecture material” was already learned through resident self-study in the preparatory work, thus enabling the facilitator to directly “jump” to more complicated and difficult application problems subsequent to the IRAT and GRAT test scores. Although the GRAT includes the same questions as the IRAT, the importance of the GRAT is not only the teamwork achieved by answering questions together, but also the beginning of residents teaching their peers and the group discussing each question together to achieve the best answer. The difference between IRAT and GRAT scores demonstrates that resident learning is further internalized in the group setting. The team performance survey results suggest that participation of all team members was effective; that discussion of members’ different opinions was respectful and productive, which allowed the group to arrive at a consensus answer; and that the group learning experience is perceived in a favorable manner by the participants.

To our knowledge, this is the first study to examine the effectiveness of TBL in promoting learning and teamwork in the setting of an anatomic and clinical pathology residency training program. Our results corroborate those of previous

studies that explored the applicability and feasibility of TBL in residency training programs, including primary care,9 psychiatry,10 and physical medicine and rehabilitation.11 Similar to our study, Shellenberger et al9 demonstrated higher group than individual scores on the readiness assurance test, and Touchet and Coon10 showed a high level of enthusiasm and engagement during TBL among its participants.

TBL provides residents with an engaging and supportive environment in which they can develop critical thinking skills and learn to work collaboratively as a team to approach and solve challenging problems commonly encountered in practice. In the course of the readiness assurance tests and application-oriented activities, residents are compelled to arrive at an answer when, as is often the case in clinical decision making processes, there may be more than one correct answer. In accomplishing this task, the residents are encouraged to draw upon current literature and evidence-based medicine and to defend their interpretations of, and decisions based upon, such evidence. During a TBL session, therefore, a discussion is generated with residents defending their group’s choice to their peers that provides a deeper learning experience for all participants through challenging and intellectual discourse. Thus, TBL sessions allow residents to learn to collaborate in a productive manner, which relates to the Accreditation Council for Graduate Medical Education (ACGME) competencies of professionalism and interpersonal and communication skills.

Following the four TBL sessions, the faculty facilitators provided written feedback. They found TBL to be a productive use of their time and skills, as well as an enjoyable and rewarding experience, with one facilitator remarking that the session was “alive and engaging” and another commenting “I absolutely love TBL.” The facilitators noted that preparation time for the TBL session (providing prework, creating IRAT and GRAT, producing the problem-oriented activity) took longer than the usual didactic session preparation, but in the end they felt the extra effort was well invested. They commented that the resident learning achieved through the process was “obvious” and that the residents showed a high level of participation and worked well together. Facilitators observed that most residents were prepared and had done the assigned prework, which provided the residents with the necessary foundation to meaningfully engage with the group exercises.

Study limitations include the small sample size as well as the fact that it was a subjective measurement tool (using a
<table>
<thead>
<tr>
<th>Item</th>
<th>Session 2 (Interstitial Lung Disease)</th>
<th>Session 3 (Death Certification)</th>
<th>Session 4 (Delayed Hemolytic Transfusion Reactions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. All team members made an effort to participate in discussions.</td>
<td>5.6 (0.6)</td>
<td>6.0 (0.0)</td>
<td>5.8 (0.4)</td>
</tr>
<tr>
<td>2. When team members had different opinions, each member explained his or her point of view.</td>
<td>5.3 (1.0)</td>
<td>6.0 (0.0)</td>
<td>5.9 (0.3)</td>
</tr>
<tr>
<td>3. Team members encouraged one another to express their opinions and thoughts.</td>
<td>5.3 (0.9)</td>
<td>6.0 (0.0)</td>
<td>5.8 (0.4)</td>
</tr>
<tr>
<td>4. Team members shared and received criticism without making it personal.</td>
<td>5.8 (0.6)</td>
<td>6.0 (0.0)</td>
<td>5.9 (0.3)</td>
</tr>
<tr>
<td>5. Different points of view were respected by team members.</td>
<td>5.8 (0.6)</td>
<td>5.8 (0.4)</td>
<td>5.8 (0.4)</td>
</tr>
<tr>
<td>6. Often members helped a fellow team member to be understood by paraphrasing what he or she was saying.</td>
<td>5.3 (1.1)</td>
<td>5.9 (0.3)</td>
<td>5.9 (0.3)</td>
</tr>
<tr>
<td>7. My team used several techniques for problem solving (such as brainstorming) with each team member presenting his or her best ideas.</td>
<td>5.5 (0.7)</td>
<td>5.8 (0.4)</td>
<td>5.9 (0.3)</td>
</tr>
<tr>
<td>8. Team members worked to come up with solutions that satisfied all members.</td>
<td>5.6 (0.8)</td>
<td>5.8 (0.5)</td>
<td>5.7 (0.6)</td>
</tr>
<tr>
<td>9. All team members consistently paid attention during group discussions.</td>
<td>5.6 (0.6)</td>
<td>5.8 (0.5)</td>
<td>5.5 (0.8)</td>
</tr>
<tr>
<td>10. My team actively elicited multiple points of view before deciding on a final answer.</td>
<td>5.6 (0.6)</td>
<td>5.7 (0.5)</td>
<td>5.7 (0.5)</td>
</tr>
<tr>
<td>11. Team members listened to each other when someone expressed a concern about individual or team performance.</td>
<td>5.6 (0.7)</td>
<td>5.8 (0.5)</td>
<td>5.7 (0.5)</td>
</tr>
<tr>
<td>12. Team members willingly participated in all relevant aspects of the team.</td>
<td>5.6 (0.7)</td>
<td>5.8 (0.4)</td>
<td>5.8 (0.4)</td>
</tr>
<tr>
<td>13. Team members resolved differences of opinion by openly speaking their mind.</td>
<td>5.8 (0.4)</td>
<td>5.9 (0.3)</td>
<td>5.8 (0.4)</td>
</tr>
<tr>
<td>14. Team members used feedback about individual team performance to help the team be more effective.</td>
<td>5.6 (0.8)</td>
<td>5.8 (0.6)</td>
<td>5.7 (0.5)</td>
</tr>
<tr>
<td>15. Team members seemed attentive to what other team members were saying when they spoke.</td>
<td>5.5 (0.9)</td>
<td>5.8 (0.4)</td>
<td>5.7 (0.5)</td>
</tr>
<tr>
<td>16. My team resolved many conflicts by compromising between team members, with each one giving in a little.</td>
<td>5.5 (0.8)</td>
<td>5.8 (0.4)</td>
<td>5.6 (0.7)</td>
</tr>
<tr>
<td>17. Members who had different opinions explained their point of view to the team.</td>
<td>5.6 (0.9)</td>
<td>5.9 (0.3)</td>
<td>5.8 (0.4)</td>
</tr>
<tr>
<td>18. Team members were recognized when something they said helped the team reach a good decision.</td>
<td>5.6 (0.8)</td>
<td>5.8 (0.6)</td>
<td>5.8 (0.4)</td>
</tr>
</tbody>
</table>

* Survey scale ranges from 0 (none of the time) to 6 (all of the time). Data given are mean (standard deviation).
survey rather than standardized examination scores). In addition, time constraints present in residency programs such as ours prevent the implementation of the 3- to 4-hour sessions originally envisioned for implementing TBL curricula. We exercised an abridged form of TBL incorporating all of the essential components, including readiness assurance process (prework, IRAT, GRAT) and application-oriented activities, in a 2-hour time frame.

Our findings should be further investigated by comparing TBL sessions with standard didactic lectures to fully understand the effectiveness of TBL vs the traditional resident education methods. Additional future studies can investigate how resident in-service and board examination scores are related to the TBL content in a residency program. As was done in this study, modifications of the basic TBL time and/or content format, with consideration of residency duties and service work responsibilities, should be investigated. Future sessions may incorporate the use of a pretest in conjunction with an audience response system as an alternative method to the IRAT/GRAT, affording more time for the group application-oriented-exercise.

In conclusion, we found that TBL has allowed for higher levels of rewarding educational engagement by both faculty members and residents, as observed by the faculty. Our study was the first to evaluate the introduction of TBL into pathology residency education, and it provided the opportunity to use teamwork in an active learning strategy. TBL has the ability to enhance residency training by raising the levels of engagement and stressing teamwork as essential. The GRAT allows residents to teach each other while achieving ACGME competencies of medical knowledge, professionalism, and interpersonal skills. Having a faculty facilitator, rather than a “teacher,” forced residents to discuss answers and explain concepts to one another. TBL has already begun to enhance our residency training and we plan to pursue TBL in future studies to find the best model for pathology residency training.

References


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