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Modified Team-Based Learning for Interprofessional Geriatric Emergency Medicine Training: Improved Knowledge Retention and High Learner Satisfaction

Maria Fernandez[1], Lucia Romero[1], Isabel Torres[1]*

[1]Department of Health Sciences, Faculty of Medicine, University of Granada, Granada, Spain.

***E-mail** ✉ isabel.torres.hs@gmail.com

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ABSTRACT

Older adults require dedicated healthcare approaches across all medical fields. Turkey currently lacks formal subspecialty training in geriatric emergency medicine (GEM). Consequently, interprofessional education for practitioners delivering GEM services is essential. Team-based learning (TBL) appears to be an effective method for such training. This study sought to design and implement a GEM training program for healthcare workers involved in these services and to assess the program in terms of participant and instructor satisfaction, as well as knowledge retention.This design-based study created a one-day GEM instructional program grounded in current evidence and expert perspectives. A modified TBL format was used to train 54 physicians, 98 nurses, 70 health officers, and 102 paramedics, ensuring each team had representatives from every discipline. Adjustments to TBL included a 1-hour lecture and the removal of peer evaluation. Evaluation tools comprised feedback surveys, individual and team assessments within the TBL process, and a retention test administered six months after training.Across all professions, team test scores exceeded individual test scores. Physicians scored higher than the other groups on the individual test; however, this difference was no longer present in the team assessment. Retention test performance surpassed the individual test mean but remained below team scores. Both instructor and learner satisfaction levels were high.The modified TBL-based program effectively delivered GEM content to multidisciplinary healthcare personnel and demonstrated favorable outcomes for knowledge acquisition, retention, and satisfaction. The instructional approach adopted here is suitable for broader applications in multidisciplinary team training.

Keywords: Interprofessional learning, Team-based learning, Geriatric emergency medicine, Long-term retention, Learner satisfaction

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Introduction

The number of older adults (aged 65+) is rising across the globe. According to the US Census Bureau, by 2034, adults aged 65 and over will—for the first time—outnumber those under 18 [1]. Between 2016 and 2060, the US population is expected to grow by roughly 25%, while those aged 65+ may nearly double, those aged 85+ may triple, and individuals aged 100+ may increase sevenfold [2]. This worldwide demographic shift underscores the necessity for specialized healthcare services for older adults, with multiple medical fields creating elderly-focused subspecialties [3].

In Turkey, per the Turkish Statistical Institute, the older adult population was around six million (8%) in 2016, increasing to 7.5 million (9.1%) by 2021, marking a 21.9% rise within five years. Projections indicate that older adults will constitute 12.9% of the population in 2030, 16.3% in 2040, and 22.6% in 2060. Based on 2020–2021 data, life expectancy at birth in Turkey was 78.3 years overall (75.6 years for men, 81 years for women) [4].

Currently, about one-third of emergency department admissions involve patients aged 65+, and this proportion is expected to grow [5]. Compared with younger adults, older patients incur higher expenses and exhibit greater

hospitalization and mortality rates [6]. Among emergency department patients aged 60+, the in-hospital mortality rate reaches 21% [7]. Increased ED utilization contributes to declining care quality, delayed treatment initiation, prolonged stays, reduced adherence to clinical standards, and heightened costs [8].

The expanding older adult population, coupled with their higher hospitalization rates, places a substantial strain on health systems. Many present with multiple chronic illnesses, are vulnerable to medication-related issues and polypharmacy, and face complex physical and social challenges. Older individuals often interact with healthcare services at numerous points, but none as frequently—or critically—as the emergency department [8].

Geriatric emergency medicine (GEM) originated in the US in 1996 as an emergency medicine subspecialty. Since then, structured training and standardized models have been developed to ensure that older adults receive appropriate, high-quality care in emergency settings [9–11]. In 2014, the American College of Emergency Physicians released the Geriatric Emergency Department Guidelines, initiating a related accreditation pathway [12]. After Europe recognized emergency medicine as a distinct specialty in 2009, the European GEM curriculum was issued in 2016 by the GEM division of the European Society for Emergency Medicine [13].

Providing appropriate care for geriatric patients requires accurate triage, well-trained staff, equipment adapted to their needs, and specialized protocols. With such systems in place, evaluations, diagnoses, and treatments become more individualized; patient outcomes improve; and unnecessary healthcare expenditures can be minimized. Therefore, developing "geriatric-friendly" emergency care programs is strongly encouraged [14].

Geriatric-focused emergency units subsequently began appearing in several European nations. When the present study was launched, Turkey had not yet implemented any structured geriatric emergency model or clinical practice. The most tangible initiative related to this area was the ERASMUS+ project, which aimed to establish the country's first geriatric-oriented emergency department capable of delivering advanced care for older adults and to create a cross-professional training program to prepare staff from multiple disciplines.

The accepted benchmark for caring for frail older individuals is the comprehensive geriatric assessment [15]. Frailty commonly involves concurrent issues that span numerous clinical specialties [16], making a broad, coordinated approach essential. Because geriatric medicine is not tied to a single medical field, effective care depends heavily on teams composed of multiple professions working together to plan and guide patient management. As such, strengthening both individual expertise and team-level skills can improve service quality. Achieving this requires instructional approaches that allow learners from different professional backgrounds to collaborate and exchange knowledge in shared learning spaces.

Interprofessional education brings together two or more professions to learn with, about, and from one another, with the goal of enhancing collaboration and improving healthcare delivery [17]. Within this context, team-based learning (TBL) is considered one of the most suitable instructional strategies for preparing multidisciplinary groups [18, 19]. Evidence from a systematic review indicates that TBL promotes stronger educational, clinical, and communication outcomes and can be employed across various branches of medicine [20].

TBL was originally developed in the 1970s by Dr. Larry Michaelsen for use in business education. He described the model as consisting of three essential components: preparatory work completed beforehand; individual and team readiness checks; and a final phase centered on application through team activities, discussion, and instructor feedback [19]. Peer assessment constitutes an optional additional stage [20]. Modified formats that incorporate only selective portions of the TBL process have also been applied [21, 22]. Today, TBL is widely integrated into undergraduate and graduate training in medicine, nursing, pharmacy, dentistry, and continuing professional development programs [19].

Within the framework of the project mentioned earlier, our intention was to prepare multi-professional teams involved in emergency care for older adults using TBL as the primary method. To date, we are unaware of any publication describing the use of TBL to deliver interprofessional training for healthcare providers engaged in geriatric emergency medicine.

Our purpose was to create and implement an instructional module for professionals working in GEM using TBL and to assess its impact on learner and instructor satisfaction as well as knowledge preservation.

Materials and Methods

Participants and ethical issues

The study focused on healthcare personnel—both pre-hospital and hospital-based—who might be responsible for emergency care of older adults. Eligible participants were individuals employed in Antalya's city center who

received an email invitation. A total of 324 participants took part: 54 physicians, 98 nurses, 70 health officers, and 102 paramedics from primary, secondary, or tertiary care facilities. The program was delivered by seven instructors experienced in emergency medicine, supported by two experts in medical education who assisted with design, delivery, and evaluation.

All participants and trainers received study information in the invitation email, and consent was obtained at the start of each survey. Since personal mobile devices were used for data entry, confidentiality concerns did not arise. No conflicts of interest were reported by the research or instructional teams.

Ethical approval for the study was granted by the University of Health Sciences, Antalya Training and Research Hospital Ethics Committee (Approval code: 20/13/November 03, 2022).

Study design

This work followed a design-based approach in which the training module was created, delivered, and evaluated. The overall structure is shown in **Figure 1**, with additional details provided in subsequent sections.

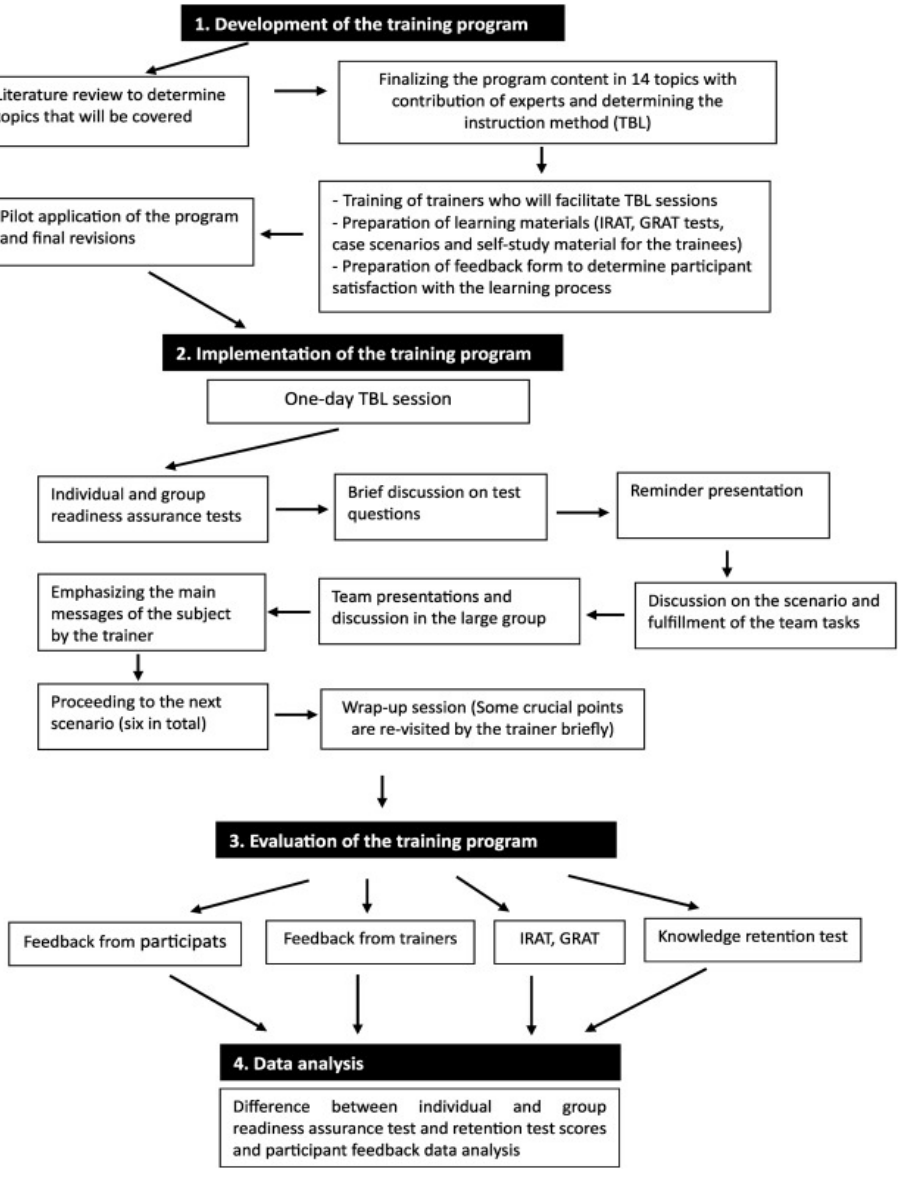

Figure 1. Study framework.

Study setting

The emergency department hosting the program treats more than 35,000 older adult patients each year. When including the emergency services of other hospitals in the same city, this figure is at least doubled. While GEM

topics are incorporated into emergency medicine residency training, there is no formal subspecialty program dedicated to geriatric emergency medicine in Turkey.

Training program development

The training program was created jointly with the Akdeniz University Medical Education Department and the Emergency Medicine Clinic of Antalya Training and Research Hospital, following four sequential phases.

In the first phase, textbooks, guidelines, and scientific papers were reviewed to determine which subjects could realistically fit into the curriculum. These proposed subjects were then examined by the research team together with emergency medicine physicians.

During the second phase, the program content was finalized, and—after consultation with medical education specialists—team-based learning (TBL) was selected as the primary pedagogical approach. The finalized list of subjects included:

1. Concept and physiology of aging
2. Communicating with older adults in both pre-hospital and hospital environments
3. Frailty in the elderly
4. Pre-hospital care of geriatric patients
5. Nursing care for older individuals
6. Alterations in mental status among older adults
7. Pain assessment and treatment in geriatric patients
8. Atypical symptom patterns in elderly populations
9. Managing life-threatening emergencies in older adults
10. Geriatric trauma
11. Elder neglect and abuse
12. Polypharmacy and drug interactions in the elderly
13. Nursing transitions of care
14. Ethical and legal considerations during resuscitation of older patients

In the third phase, trainers participated in a workshop focusing on the practical application of TBL and the types of documents required before instruction. Following this workshop, all materials were created by the research and training teams. Because TBL requires preparation before class, concise reading material and additional resources for all 14 topics were emailed to participants at least one week before the session. A set of 13 multiple-choice questions (developed using current literature) was also prepared for both individual and team readiness assessments. In addition, clinical case scenarios reflecting each program topic and emphasizing frequently encountered or multidisciplinary dilemmas in geriatric care were written for use in group discussions.

The final phase involved a pilot TBL session conducted with small groups, using the prepared tests and scenarios to identify strengths, weaknesses, and any required revisions to materials or processes.

Training program implementation

Across the two months preceding the study, the trainers carried out 16 separate one-day sessions for mixed groups of healthcare workers. Each training day involved an 8-hour program using a modified TBL format with roughly 20–25 participants. Two deviations from classical TBL were incorporated: a 1-hour lecture following the readiness tests, and elimination of peer evaluation due to the short, single-day structure. Typically, TBL includes a review of the readiness test questions; in this version, that review was expanded into a full lecture summarizing key concepts to better prepare participants for team activities. Peer assessment was omitted because reliable group interaction patterns cannot develop within a single day.

A standard session proceeded as follows:

After introductions, participants completed the individual readiness assurance test (IRAT) via Google Forms on their phones. The form also included questions on demographic background, prior geriatric emergency training, and perceived self-competence in geriatric emergency medicine. Participants then answered 13 MCQs evaluating their baseline knowledge, with 20 minutes designated for this stage.

Next, they were assigned to teams of five or six members, ensuring each group contained at least one physician, one paramedic, and one nurse. These teams completed the same 13 questions collectively during the group readiness assurance test (GRAT), with 15 minutes allowed. When the GRAT ended, trainers revealed the correct

responses and provided short explanations for common errors. Participants could challenge any answers they believed to be incorrect, and these objections were discussed as part of the readiness assurance segment. Altogether, the testing and discussion phase required 45–50 minutes.

This was followed by a 1-hour presentation delivered by one of the trainers, reinforcing essential GEM concepts. Although not a core component of traditional TBL, this segment was added due to concerns among trainers and emergency medicine experts that the GRAT and subsequent discussion alone might not sufficiently raise readiness for the team assignment phase.

The remainder of the training session was allocated to working through the six case scenarios, addressing them sequentially, and completing the group-based tasks linked to each. All groups received the same case at the same moment and were expected to examine it from the standpoint of every profession represented on their team. Each case included guiding questions or points of disagreement, and the final responses were shaped through consensus within the team. Participants were permitted to consult any resources while analyzing the case and generating solutions. Teams were given 30–45 minutes for each scenario discussion. When this period ended, a spokesperson from a randomly chosen group outlined their team's responses, proposed solutions, or ongoing challenges to the entire audience. A large-group discussion followed, during which other teams contributed questions, supplementary details, or alternative strategies. Trainers also participated, occasionally prompting the room to consider different interpretations. A trainer then closed the segment by highlighting the essential concepts and reinforcing the main lessons. The process for each scenario—from distribution to final summary—lasted 45–60 minutes.

At the end of the training day, a brief concluding session was held, during which a trainer revisited central principles of geriatric emergency management and offered final messages.

Training program evaluation

Evaluation began with the readiness test results automatically captured by the online system.

Participant satisfaction was assessed using a 17-item electronic questionnaire administered at the close of the session. Items covered logistics, infrastructure, preparation, discussion quality, instructor performance, and overall impressions. The form, accessed via mobile devices, used a 1–5 Likert scale (1 = absolutely disagree; 5 = absolutely agree). More than 90% of attendees (n = 294) completed the survey.

A parallel 17-item tool, using the same 1–5 scale, was completed by all trainers at the end of the full training period. Total possible scores for both groups ranged from 17 to 85.

To assess longer-term information retention, the same MCQ set used in the readiness phase was re-administered six months later via an online platform. All participants except two health officers completed this follow-up (n = 322).

Data analysis

Data exported from the online system were analyzed using SPSS version 24.0 (IBM Corp., Armonk, NY, USA). Descriptive results were used to summarize mean and median values. Differences between IRAT and GRAT mean correct-answer counts were examined with paired samples t-tests. Variations among IRAT, GRAT, and retention scores were evaluated using repeated measures analysis. A one-way ANOVA compared results across professional categories and across self-reported competency levels. The Mann–Whitney U test examined IRAT differences between those with and without earlier GEM training. Statistical significance was defined as $p < 0.05$.

Results and Discussion

Participants had a mean age of 34.7 ± 8.17 years, and roughly two-thirds were women (219/105). Prior GEM training had been completed by 22 individuals (6.8%). Self-ratings showed 81 participants feeling fully competent, 210 partly competent, and 33 not competent in geriatric emergency care.

The mean correct-answer counts for the 13-item IRAT and GRAT were 7.75 ± 2.48 and 11.54 ± 1.07, respectively, with a significant gap between them (paired samples t-test, $p < 0.001$). Physicians achieved higher IRAT scores than the other groups (one-way ANOVA, $p < 0.001$; **Table 1**). No significant difference was observed between those with prior training and those without (8.4 ± 2.3 vs. 7.7 ± 2.5; Mann–Whitney U, $p = 0.199$). IRAT scores also did not differ across the three perceived-competency groups—competent (8.0 ± 2.5), partly competent (7.7 ± 2.5), and not competent (7.1 ± 2.1) (one-way ANOVA, $p = 0.221$). Across every profession, GRAT scores

exceeded IRAT scores (paired samples t-test, $p < 0.001$). Unlike the IRAT, GRAT performance did not vary across professions (one-way ANOVA, $p = 0.785$) **(Table 1).**

Table 1. Average readiness-test scores by profession.

	Physician	Nurse	Paramedic	Health officer	P[a]
IRAT	9.89 ± 1.87	7.71 ± 2.34	7.28 ± 2.50	6.84 ± 2.12	<0.001
GRAT	11.70 ± 0.93	11.57 ± 1.19	11.42 ± 1.04	11.39 ± 1.27	0.785

aOne-way analysis of variance.

The retention test mean was 8.89 ± 2.80, higher than the IRAT average but lower than the GRAT average (repeated measures analysis with Bonferroni correction, $p < 0.001$) **(Table 2).**

Table 2. Readiness and retention scores across professional groups.

	IRAT	GRAT	Retention test	P[a]
Physician	9.89 ± 1.87	11.70 ± 0.93	10.50 ± 1.74	0.033
Nurse	7.71 ± 2.34	11.57 ± 1.19	9.55 ± 1.97	<0.001
Paramedic	7.28 ± 2.50	11.42 ± 1.04	9.54 ± 2.55	<0.001
Health officer	6.84 ± 2.12	11.39 ± 1.27	6.71 ± 3.40	0.003
Total	7.75 ± 2.48	11.54 ± 1.07	8.89 ± 2.80	<0.001

aRepeated measures analysis.

The average satisfaction score reported by participants was 81.3 ± 6.19 out of 85, with no variation across professional groups (one-way ANOVA, $p = 0.748$). The mean ratings for the five thematic categories of the participant questionnaire, broken down by profession, are listed in **Table 3**, and again, no significant differences were detected. Trainers reported an even higher mean satisfaction score of 84.6 ± 4.46 out of 85. Participant comments were overwhelmingly favorable. Only two individuals noted that the 1-hour lecture was not especially helpful; nonetheless, their overall scores remained high (77 and 81 out of 85), and they added that a lecture-only format would have caused them to lose focus. All trainers reported a positive instructional experience. Most participants, along with every trainer, stated that they would like this approach to be used in future educational programs.

Table 3. Average feedback scores for each professional category.

SUBJECTS	PHYSICIAN	NURSE	PARAMEDIC	HEALTH OFFICER	P[a]
Organization	4.73 ± 0.43	4.66 ± 0.47	4.71 ± 0.43	4.64 ± 0.53	0.565
Preparation/readiness	4.81 ± 0.36	4.77 ± 0.49	4.79 ± 0.38	4.72 ± 0.52	0.725
Discussions	4.85 ± 0.37	4.87 ± 0.41	4.87 ± 0.37	4.84 ± 0.40	0.372
Trainers	4.79 ± 0.44	4.79 ± 0.80	4.83 ± 0.35	4.81 ± 0.43	0.885
General	4.87 ± 0.28	4.81 ± 0.44	4.78 ± 0.48	4.68 ± 0.61	0.143
Overall	4.82 ± 0.31	4.79 ± 0.40	4.80 ± 0.33	4.72 ± 0.45	0.451

aOne-way analysis of variance.

This project aimed to design, deliver, and assess a training program on GEM for healthcare personnel. The findings show both the need for such training and the value of the program in improving knowledge, supporting retention, and generating high levels of satisfaction among instructors and learners. The discussion below is organized around these points.

Two observations underline the necessity of a structured GEM training program. First, there is no existing national curriculum or subspecialty track in GEM. Second, our data suggest that prior exposure to related training does not translate into better baseline performance. Although some participants reported earlier education in geriatric care and rated themselves as competent or partially competent, their IRAT scores were not significantly different from those who lacked such training or who did not feel confident in their abilities. This outcome points clearly to the need for standardized GEM training—even among those who believe they are already adequately prepared.

TBL was selected as the primary teaching strategy because it aligns well with interprofessional education, allowing different disciplines to share perspectives and integrate their expertise. Our expectations were confirmed: while physicians achieved higher IRAT scores initially, all professions showed improvement, and these differences disappeared when teams completed the GRAT together. This pattern indicates that participants benefitted from each other's knowledge and jointly constructed a stronger conceptual understanding.

Follow-up testing six months later demonstrated that knowledge levels for all groups—except health officers—remained above their initial scores, though below the levels observed during the GRAT. This outcome is consistent with previous reports acknowledging some degree of decline in retained knowledge over time [18, 23–25]. Since both IRAT and retention scores reflect individual performance, the sustained difference between them suggests that the program contributed positively to long-term retention. This may be linked to the active participation required by TBL, where learners analyze and debate each topic in depth. Some studies argue that TBL is more beneficial for long-term than short-term retention [26], possibly because summative assessments taken immediately after instruction encourage temporary memorization regardless of teaching method. Others have reported the opposite pattern, showing stronger short-term but weaker long-term retention for TBL [27], which could relate to poor engagement, insufficient motivation, or a limited sense of relevance among certain groups. In our context, refresher sessions on GEM may help mitigate knowledge decline. The lower retention scores among health officers might reflect their more limited involvement in direct decision-making during patient care; with fewer chances to apply the material, it may be more easily forgotten. This explanation would have been strengthened if we had collected data on whether participants used the course content in clinical practice—an acknowledged limitation.

Another important measure of program quality was satisfaction among participants and trainers. Both groups expressed high levels of approval. Several factors may have contributed: strong engagement with the learning tasks, clear enthusiasm for the subject matter, positive trainer–learner interactions noted in the feedback, and the practical relevance of the scenarios. Previous research indicates that TBL tends to enhance motivation and participation when compared to lecture-based formats [25, 26]. The hybrid nature of our program—which blended a 1-hour presentation with classical TBL components—may also have appealed to individuals with different learning preferences.

Postgraduate programs are typically delivered through traditional instructional formats, and interprofessional learning opportunities often rely on similarly conventional approaches. In contrast, this work stands out for strongly advocating the incorporation of TBL into postgraduate, team-based education. To the best of our knowledge, it is the first report to detail both the application and the outcomes of an interprofessional training initiative employing a modified TBL framework within the context of GEM.

This project also has several noteworthy constraints. The main issue relates to how broadly the results can be applied. Since the program was carried out in a single setting and included only certain categories of healthcare personnel from one region, the findings cannot be extended to larger populations without caution. Broader studies with more diverse and numerous participants are needed to strengthen external validity. Another limitation involves the study's design: no alternative instructional approaches were compared. Although some participant comments allowed limited contrasts between the 1-hour lecture and the remainder of the training, it remains unclear whether comparable outcomes would occur if the curriculum were delivered solely through other methods (for example, only lectures). Future investigations could address this gap by conducting comparative evaluations of different instructional strategies, similar to studies commonly done in undergraduate medical education.

A further limitation is that participants' initial knowledge levels were not measured before they received the self-study resources. Baseline data would have allowed a clearer assessment of how much learning resulted from the entire educational sequence, including pre-session preparation. Moreover, although improvements in knowledge acquisition and retention were encouraging, the study did not explore whether these learning gains translated into better care for older adults treated in emergency settings. Subsequent research might examine whether similar training programs influence patient outcomes by comparing those treated by program graduates with those treated by clinicians who did not participate. Finally, program cost may represent an obstacle, given the need for dedicated teaching spaces, technological and material resources, and potential compensation for facilitators and support staff.

Conclusion

This work is distinctive in its strong endorsement of using TBL in postgraduate interprofessional training. We applied a modified TBL structure to deliver education on GEM topics to relevant healthcare providers and observed positive effects on knowledge improvement, longer-term retention, and satisfaction among both learners and instructors. These findings indicate that the instructional model used here may be suitable for wider use in multidisciplinary team training. We encourage future researchers working on multiprofessional education to

design their studies with these limitations in mind and to evaluate the effectiveness of their programs using at least some of the outcome measures highlighted in this study.

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