

Effectiveness of Online Team-based Learning for Pharmacists on How to Conduct Clinical Medication Reviews for Old Patients in Japan: A Randomized Controlled Trial

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Abstract. *Background/Aim:* This study aimed to determine the effectiveness of online team-based learning (TBL) and the factors influencing dropouts from online TBL for pharmacists on how to conduct clinical medication reviews for older adults. *Participants and Methods:* All participants were randomly assigned to the TBL or non-TBL group by using a random number sequence table matched by their years of experience working as a pharmacist. The primary outcome was whether the score on the team readiness assurance test (TRAT) in the TBL group differed from that on the second individual readiness assurance test (IRAT) in the non-TBL group. The secondary outcome was to identify factors contributing to dropouts from the online TBL program. *Results:* The TRAT score in the TBL group was significantly higher than the second IRAT score in the non-TBL group during the first session ($p=0.010$). There were no differences in TRAT and IRAT scores between groups in two subsequent sessions. Logistic regression analysis revealed that less than 10 years of

pharmacy experience was a contributor to dropouts ($p=0.039$), whereas experience in home-based care prevented dropouts ($p=0.026$) in our online TBL program. *Conclusion:* This study revealed the short-term usefulness of online TBL on medication reviews for older adults and elucidated the factors related to dropouts. Although instructors should provide positive feedback to participants with insufficient experience in pharmacy practice and home-based care, online TBL has the potential to improve educational effectiveness for community pharmacists during the COVID-19 pandemic.

Team-based learning (TBL) is a structured educational method involving learning in small groups that incorporate active learning strategies (1). It was introduced to accommodate increased class sizes and change learning from large group lectures to learning in small teams in business schools (2). TBL has also been introduced in medical and healthcare education (3). It can be applied to large (>100 students) and small (<25 students) classes that can contain multiple groups of five to seven students (3). Several studies and reviews have demonstrated the effectiveness of TBL in health professions education (2, 4-11). Individual readiness assurance tests (IRATs) and team readiness assurance tests (TRATs) are used to assess individual preparation and team discussion effectiveness, respectively. TBL may also include a peer-review process that provides learners in teams with an opportunity to evaluate the overall team effectiveness and the contribution by each individual to the team (4). Due to such evidence, TBL has been introduced in more than 20 fields in healthcare education including medicine, dentistry, pharmacy, nursing, and social work.

The coronavirus disease 2019 (COVID-19) pandemic has disrupted healthcare workforce education conducted in

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Key Words: COVID-19, team-based learning, online, pharmacist, randomized controlled trial.



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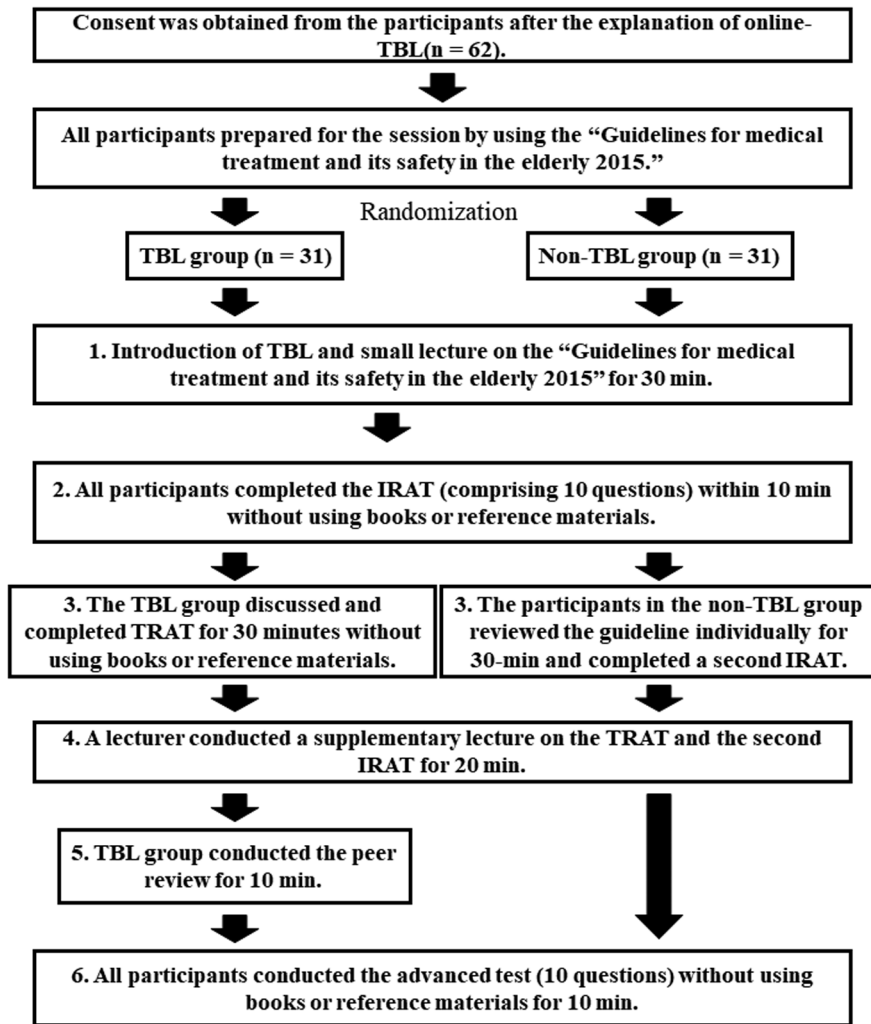


Figure 1. Team-based learning (TBL) procedure in the present study. Steps 1 to 5 were repeated in each session. IRAT: Individual readiness assurance test; TRAT: team readiness assurance test.

person (12), leading to innovations that facilitate remote learning programs. These virtual or online learning programs have contributed to the continuity of healthcare professional education during the pandemic; however, most programs have been lecture-based only. Previous research has provided some tips for conducting online TBL during the pandemic (13-15). Selection of an appropriate software package for the online discussion, preparation to use the software package, and online discussion using an ideal chat application are keys to the success of an online TBL (15). For instance, the Zoom online meeting platform has a breakout room capability that supports placing participants into small groups to facilitate more intimate discussion or teamwork on a project or assignment. An effective chat application achieves an ideal, synchronous online TBL setting by allowing participants to express their ideas or share their responses in a textbox

without having to speak up in a large group. The Zoom online platform also contains a chat capability for communication with all participants, meeting hosts, or individual participants privately, based on the setting selected by the host or instructor. Using these available interactive features, online TBL may facilitate mastery and authentic application of knowledge, development of effective teamwork, and self-directed learning to a similar degree as face-to-face TBL.

Face-to-face and online TBL are recognized as ideal methods of active learning; however, factors influencing dropout rates of either TBL have not been reported in the field of health professional education. Determining these factors may contribute to improving the online TBL implementation and participant experience. This study aimed to determine the effectiveness of an online TBL compared

Table I. Contents of preparation for team-based learning.

First session
Pharmacotherapy precautions for older adults
- Avoidance of adverse drug reactions
- Medication management and/or support
- Screening tool for appropriate prescribing to older adults
- List of “drugs that require particularly careful administration”
- List of “drugs to consider starting”
Area-specific guidelines
- Psychiatric disorders (behavioral and psychological symptoms of dementia, insomnia, depression)
- Neurological disorders (dementia, Parkinson's disease)
Second session
- Respiratory diseases (chronic obstructive pulmonary disease, pneumonia)
- Cardiovascular disease (arrhythmia, thrombosis, heart failure)
- High blood pressure
- Renal disease (renal failure, chronic kidney disease)
- Gastrointestinal disorders (constipation, gastroesophageal reflux disease)
- Diabetes
- Dyslipidemia
Third session
- Urinary tract disorders [urinary obstruction (overactive bladder, anterior urethral hypertrophy)]
- Musculoskeletal diseases (osteoporosis, rheumatoid arthritis)
- Herbal medicine and East Asian traditional medicines
- In-house medical therapy
- Nursing-home healthcare
- Roles of pharmacists

with self-learning and the factors influencing dropout rates for pharmacists learning to conduct clinical medication reviews for older adults.

Participants and Methods

Study protocol. The study participants were pharmacists in Japan, who participated in a workshop consisting of three learning sessions on “Guidelines for medical treatment and its safety in older adults 2015” published by the Japan Geriatrics Society. The purpose of this workshop, developed by the members of the Japanese society of geriatric pharmacy, was to teach community pharmacists in Japan how to conduct clinical medication reviews for older adults. Because of the COVID-19 pandemic, the in-person learning strategy was restricted, and the online TBL format was used in a workshop consisting of three learning sessions on “Guidelines for medical treatment and its safety in older adults 2015”, where small groups of five to six participants were established during the first session. One session was held per month, and total sessions were three during this study. This workshop procedure is illustrated in Figure 1. Informed consent to participate in the randomized research was obtained from all participants prior to their participation. All participants prepared for each session by pre-learning corresponding sections of the “Guidelines for medical treatment and its safety in older adults 2015” beforehand (Table I).

Table II. Baseline characteristics.

Characteristics	TBL group (n=31)	Non-TBL group (n=31)	p-Value
Years of experience			
<5 years, n, percent	5 (16.1)	8 (25.8)	0.534 ^a
<10 years, n, percent	11 (35.5)	12 (38.7)	0.793 ^b
Education system-guaranteed pharmacist			
Yes, n, percent	21 (67.7)	24 (77.4)	0.570 ^a
No, n, percent	10 (32.3)	7 (22.6)	
Experience in home-based care			
Yes, n, percent	24 (77.4)	28 (90.3)	0.301 ^a
No, n, percent	7 (22.6)	3 (9.7)	

^aFisher's exact test, ^bChi-square test.

All participants were randomly assigned to TBL group or non-TBL group by using a random number sequence table matched by their years of experience working as a pharmacist. To prevent allocation bias, randomization was conducted by a researcher who was not involved in the study data analysis. After randomization, a 30-min presentation introduced TBL followed by a short lecture on pharmacotherapy for older adults. Subsequently, all participants completed a 10-min IRAT (comprising 10 questions) without using any books or reference materials. Then the TBL groups discussed and completed TRAT for 30 min without using any books or reference materials. The participants in the non-TBL group spent the 30 min reviewing the Guideline on their own and completed a second IRAT. A supplementary lecture was provided to all participants on the TRAT and the second IRAT for 20 min. Participants who did not complete the IRAT and/or TRAT at any time, or those who did not attend every session were excluded from data analysis. The primary outcome of this study was to evaluate whether the TRAT score in the TBL group differed from the second IRAT score in the non-TBL group. The secondary outcome was to identify factors contributing to dropout rates from the online TBL program.

Self and peer evaluations. Each participant in the TBL group evaluated themselves and their team members by providing feedback about their contributions to the learning process and decision-making during the team discussion using a scale of 1 to 10, with 1 indicating “strongly disagree” and 10 signifying “strongly agree.” The terms of self and peer evaluations included: 1) preparation for teamwork, 2) contribution to teamwork, 3) positivity for teamwork, 4) respect for teammates' opinions, and 5) flexibility for teamwork.

Statistical analysis. The analyses in this study were conducted in a single-blind manner. Normally distributed data are presented as mean±standard deviation values. Non-normally distributed data are reported as medians and ranges. Student's *t*-test and Mann-Whitney *U*-test were used to compare normally and non-normally distributed data, respectively. Fisher's exact and chi-square tests were used to evaluate categorical variables. Logistic regression analysis using a multivariate model was performed to determine factors contributing to dropping out of the TBL program. The terms

Table III. Scores of individual readiness assurance test (IRAT) and team readiness assurance test (TRAT).

Characteristics	TBL group (n=31)	Non-TBL group (n=31)	Number of participants (TBL/non-TBL)	p-Value
IRAT score (1 st), mean (SD)	4.61 (1.73)	5.25 (1.65)	31/24	0.172 ^a
TRAT or second IRAT score (1 st), median (range)	9.00 (7-10)	7.29 (2-10)	31/24	0.010 ^b
IRAT score (2 nd), median (range)	6.00 (3-10)	6.30 (4-8)	25/21	0.822 ^b
TRAT or second IRAT score (2 nd), median (range)	9.00 (8-10)	8.80 (5-10)	25/21	0.402 ^b
IRAT score (3 rd), mean (SD)	6.55 (1.60)	6.30 (1.56)	22/20	0.617 ^a
TRAT or second IRAT score (3 rd), median (range)	9.00 (7-9)	8.70 (2-10)	22/20	0.731 ^b

SD: Standard deviation; TBL: team-based learning; ^aStudent's *t*-test, ^bMann-Whitney *U*-test.

used in the multivariate model were “TBL group”, “Years of experience <10 years”, and “Experience of home-based care”. To test the goodness-of-fit for the logistic regression models, the Hosmer-Lemeshow test was conducted. All statistical analyses were performed using SPSS software (version 22.0; SPSS Inc., Chicago, IL, USA). A two-sided *p*-value of <0.05 was considered significant in all statistical analyses.

Ethics approval. This study was approved by the Ethics Board of Sugi Pharmacy (approval number: 2022-1-07).

Results

Baseline characteristics of the participants. The study flowchart is shown in Figure 1. Overall, 62 participants were enrolled and randomly assigned to the TBL group (n=31) or non-TBL group (n=31) matched by their years of pharmacist experience. The baseline characteristics are shown in Table II. There were no differences in the three characteristics regarding career and specialty of the included pharmacists between the two groups.

IRAT and TRAT scores. The IRAT and TRAT scores are presented in Table III. In the first workshop session, after the introduction of TBL and the Guideline, the IRAT scores did not significantly differ between the TBL and non-TBL groups (TBL group: 4.61±1.73, non-TBL group: 5.25±1.65, *p*=0.172). However, after the TBL discussion and individual learning, the TRAT score in the TBL group was significantly higher than the second IRAT score in the non-TBL group [TBL group: 9.00 (range=7-10), non-TBL group: 7.29 (range=2-10), *p*=0.010].

In the second workshop session, the IRAT scores did not significantly differ between the TBL and non-TBL groups [TBL group: 6.00 (range=3-10), non-TBL group: 6.30 (range=4-8), *p*=0.822]. Also, the TRAT score in the TBL group was similar to the second IRAT score in the non-TBL group [TBL group: 9.00 (range=8-10), non-TBL group: 8.80 (range=5-10), *p*=0.402].

In the third TBL session, the IRAT scores did not significantly differ between the TBL and non-TBL groups

Table IV. Factors influencing dropping out from team-based learning (TBL).

Characteristics	OR (95%CI)	p-Value
All participants		
-TBL group		
Yes	0.526 (0.150-1.849)	0.317
No	1 [Reference]	
-Years of experience		
≥10 years	1 [Reference]	0.039
<10 years	3.534 (1.065-11.73)	
-Experience in home-based care		
Yes	0.141 (0.027-0.725)	0.019
No	1 [Reference]	
Participants in the TBL group		
-Years of experience		
≥10 years	1 [Reference]	0.069
<10 years	6.065 (0.870-42.27)	
-Experience in home-based care		
Yes	0.089 (0.011-0.753)	0.026
No	1 [Reference]	

OR: Odds ratio; CI: confidence interval; N/A: not available.

(TBL group: 6.55±1.60, non-TBL group: 6.30±1.56, *p*=0.617). Again, there was no significant difference between the TRAT score in the TBL group and the second IRAT score in the non-TBL group [TBL group: 9.00 (range=7-9), non-TBL group: 8.70 (range=2-10), *p*=0.731].

Factors influencing dropout rates. Six and 10 participants dropped out of the TBL group and non-TBL group after the first session, respectively. Three and one participants dropped out from the TBL and non-TBL groups, respectively in the second session. Twenty-two and 20 participants in the TBL and non-TBL groups, respectively, completed all sessions in the workshop. To determine the factors contributing to dropouts, a logistic regression analysis was performed using a multivariate model. It revealed that “Years of experience <10 years” was a factor contributing to dropouts [odds ratio (OR)=3.534, 95% confidence interval

Table V. Results of self and peer reviews in the team-based learning (TBL) group.

Characteristics	Self-review (1 st) (n=30)	Peer review (1 st) (n=31)	Self-review (2 nd) (n=24)	Peer review (2 nd) (n=25)	Self-review (3 rd) (n=22)	Peer review (3 rd) (n=22)
Preparation for teamwork [score; median (range=1-10)]	4.50 (1-10)	7.00 (1-10)	6.00 (2-10)	8.00 (4-10)	6.50 (1-10)	8.00 (3-10)
Contribution to teamwork [score; median (range=1-10)]	6.00 (1-10)	8.00 (1-10)	8.00 (3-10)	8.00 (4-10)	7.00 (4-10)	9.00 (3-10)
Positivity for teamwork [score; median (range=1-10)]	7.00 (2-10)	8.00 (3-10)	8.00 (5-10)	8.00 (4-10)	8.00 (3-10)	9.00 (3-10)
Respect for teammates' opinions [score; median (range=1-10)]	7.00 (3-10)	8.00 (1-10)	8.00 (4-10)	8.00 (4-10)	8.00 (5-10)	9.00 (3-10)
Flexibility for teamwork [score; median (range=1-10)]	7.00 (3-10)	8.00 (1-10)	8.00 (4-10)	9.00 (4-10)	8.00 (5-10)	9.00 (3-10)

(CI)=1.065-11.73, $p=0.039$]. In contrast, “Experience in home-based care” was a factor preventing against dropout (OR=0.141, 95%CI=0.027-0.725, $p=0.019$). Although the number of dropouts was higher in the non-TBL group than in the TBL group, TBL format was not a preventive factor (OR=0.526, 95%CI=0.150-1.849, $p=0.317$). The result of the Hosmer-Lemeshow test showed a goodness-of-fit for the logistic regression models ($p=0.630$) (Table IV).

Similar results were obtained from the logistic regression analysis in the TBL group [“Years of experience <10 years” (OR=6.065, 95%CI=0.870-42.27, $p=0.069$), “Experience of home-based care” (OR=0.089, 95%CI=0.011-0.753, $p=0.026$)]. Although the number of dropouts in the TBL group was smaller, the result of the Hosmer-Lemeshow test showed a goodness-of-fit for the logistic regression models ($p=0.600$) (Table IV).

Self-evaluation and peer review. The results of the self-evaluation and peer reviews in the TBL group are shown in Table V. One participant could not conduct a self-evaluation in the first and second sessions of TBL because of a poor internet connection. The preparation and contribution scores for teamwork increased from the first to the second and third sessions. The scores for positivity for teamwork, respect for teammates' opinions, and flexibility for teamwork remained constant across all sessions.

Discussion

Older adults have multiple chronic conditions including geriatric syndromes that may result in polypharmacy use and prescribing cascade, which could lead to various adverse drug reactions (ADRs) (16-18). To decrease the number of ADRs, pharmacists should recognize potentially inappropriate medications (PIMs) used by older adults through a clinical medication review. A clinical medication

review is recognized as an ideal method for assessing and resolving ADRs in older people. However, young pharmacists without sufficient experience in geriatrics and practice with geriatric medication management find it difficult to conduct clinical medication reviews for older adults. The clinical guidelines published by the Japan Geriatrics Society support pharmacists to conduct clinical medication reviews to avoid ADRs and detect PIMs. To develop an educational structure for training professional pharmacists in geriatrics, clinical clerkships have been established by the Japan Geriatrics Society and the Japanese Society of Geriatric Pharmacy. However, because of the COVID-19 pandemic, young pharmacists have lost the opportunity to learn the clinical guidelines through clerkship rotations and workshops. To fill this gap in training, an online TBL workshop was created to facilitate participants to learn the clinical medication review procedures.

Because this is the first implementation of the online TBL in the field of geriatric pharmacy, we performed this study to evaluate the effectiveness of the workshop. The primary outcome was partially achieved with a significant score difference during the first session of the workshop between online TBL and non-TBL participants. Therefore, online TBL may be useful in facilitating the acquisition of knowledge covered in the first session including avoidance of ADRs in older adults, medication management, and screening tool for appropriate prescribing to older adults. However, the usefulness of online TBL was not observed in the second or third sessions pertaining to the disease-specific sections of the guidelines (*i.e.*, respiratory diseases and urinary tract disorders).

Active learning is an ideal method for providing feedback by instructors to participants and establishing a connection between new concepts and prior knowledge through discussions among the participants. The attendees need to both prepare well for and fully participate in

interactive components for active learning to be effective. The mean IRAT score in the first session was lower than those in the second and third sessions. Additionally, the scores of self-evaluation and peer reviews in the TBL group were high among the participants in the second and third sessions. These results may mean that the preparation for teamwork might not have been enough in the first session, and TBL strategy compensated for low preparedness in the TBL group.

We conducted a logistic regression analysis to elucidate the reason for our study findings. Seven and nine participants dropped out of the TBL and non-TBL groups, respectively. Most of the participants who dropped out had less than 10 years of experience working as pharmacists or had limited experience with home-based care as pharmacists. These results suggest that the participants who did not have enough experience in home-based care benefitted from teamwork in improving their knowledge regarding geriatric pharmacy during the first session. Yet such participants may have dropped out of the workshop before the second or third session; therefore, the usefulness of online TBL may not have been retained after the first session. To prevent dropouts, instructors should provide positive feedback to participants who have less than 10 years of pharmacy experience or lack of home-based care experience to encourage continued learning through the workshop.

Study limitations. First, we could not evaluate whether the participants' clinical medication review skills improved or not. In future studies, online TBL participants' skills using interventions for PIMs identification and resolution could be assessed. Second, IRAT quality was not evaluated. The level of difficulty and whether the IRAT content is comprehensive enough should be considered in further studies. Thus, we were unable to conclude whether a lack of experience working as a pharmacist or the IRAT content affected the scores of second and third sessions. Third, internet connectivity was poor during the first and second sessions in the online workshop. The selection of most effective software packages for online TBL should be considered in future studies.

In conclusion, our study found the short-term effectiveness of an online TBL workshop and higher dropout rates among participants with less than 10 years of pharmacy experience and lack of home-based care experience. This learning method has the potential to improve educational quality for pharmacists seeking geriatrics expertise during the COVID-19 pandemic.

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Conflicts of Interest

The conflicts of interest from the past three years are as follows: YA, MS, and NM are employees of Sugi Pharmacy Co., Ltd. SS is the vice-president of Sugi Pharmacy Co., Ltd and has the stock of Sugi Pharmacy Co., Ltd. SY received research support from Sugi Holdings Co., Ltd. TM received honoraria from WELCIA Holdings Co., Ltd.

Authors' Contributions

YA, TM, and MS contributed to the study conception and design. YA, NM, MS, and SS contributed to data interpretation. SS, FM, JKL, and SY designed the study and reviewed the manuscript. TM contributed to the data analysis, drafted the manuscript, and supervised the study.

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