Original Article

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A blended learning program sustains pharmacists' oral health support competency for 15 months: A longitudinal study

Naoko Hayashi[1,2], Tomoyuki Goto[3,4], Yasuo Shiga[5,6], Mitsuhiro Okazaki[7,8], Atsuhiko Sano[9,10], Narumi Maida[1,2], Hiroki Iwata[1,2], Hikaru Matsui[11], Shingo Kondo[1,2], Noriko Kobayashi[1,2], Katsunori Yamaura[1,2,*]

[1] Keio University Community Pharmacy, Tokyo, Japan;
[2] Division of Social Pharmacy, Center for Social Pharmacy and Pharmaceutical Sciences, Faculty of Pharmacy, Keio University, Tokyo, Japan;
[3] FUREAI Dental Clinic, Tokyo, Japan;
[4] Shinjuku Shoku-Shien Kenkyukai (Shinjuku Food Support Study Group), Tokyo, Japan;
[5] i-Stat Co., Ltd., Tokyo, Japan;
[6] Business Breakthrough University, Tokyo, Japan;
[7] Telemedicine Development and Research Center, Graduate School of Medicine, Akita University, Akita, Japan;
[8] Smart Healthcare Association, Tokyo, Japan;
[9] Nippon Pharmacy Association, Tokyo, Japan;
[10] Tanabe Pharmacy Inc., Tokyo, Japan;
[11] Tsuruha Holdings Co., LTD., Hokkaido, Japan.

SUMMARY: The importance of oral health has gained increasing recognition in the recent years owing to its association with numerous systemic diseases such as diabetes and cardiovascular disease. Dental checkups are crucial for maintaining and promoting oral health; however, in Japan, a relatively low uptake of dental checkups remains a challenge. Community pharmacists are expected to play a vital role in supporting the health and well-being of local residents; however, they have been observed to be reluctant to provide support in the oral health domain. This study aimed to develop and evaluate a blended learning training program on oral health support aimed at educating pharmacists working in health support pharmacies. The training, which involved online learning and on-site training, covered topics such as the importance of oral health, methods of oral health assessment, and the mechanisms of eating and swallowing. The participants, including a total of 39 pharmacists from across the country, completed surveys before and after the training, as well as at 9 months and 15 months posttraining. The results demonstrated a significant improvement in the pharmacists' knowledge, explanatory abilities, and confidence in providing oral health support, and these effects were observed to persist for up to 15 months after the training had ended. In addition, the variety of oral health-related products in pharmacies increased. This blended learning program demonstrates the potential to redefine the role of pharmacists in promoting oral health and contribute to the improvement of oral health among local residents.

Keywords: oral health, pharmacist education, blended learning, health support, knowledge, explanatory abilities, confidence

1. Introduction

In recent years, the significance of oral health has been gaining increasing attention. Deteriorating oral health has been associated with multiple systemic diseases. Periodontal disease is known to be linked to diabetes (*1,2*), hypertension (*3*), heart disease (*4*), cerebrovascular disease (*5*), and even fetal development (*6,7*). Age-associated oral frailty more likely to affect older adults, individuals with underlying health conditions (*8*), and those taking multiple medications. Previously conducted research by us has also demonstrated a connection between drug-induced dysphagia due to polypharmacy (*9*), because of which the aspiration of oral bacteria leads to the development of aspiration pneumonia. Recognizing the association between oral frailty and systemic frailty (*10*), the government aims to introduce nationwide dental checkups. However, across Japan, the response of the population to dental checkup visits has been observed to be low (*11*).

On the other hand, pharmacists must possess in-depth knowledge to identify drug-induced oral side effects and

implement appropriate preventive measures. In addition to providing prescription medications, community pharmacists need to engage in maintaining and promoting the health of local residents as well. To clarify this role, the health support pharmacy has been established, which is defined by the Patient-Oriented Pharmacy Vision of 2015 (*12*) as a pharmacy that actively and concretely supports the health of local residents. In addition to the common expectations of accepting health consultations, selling Over-the-Counter (OTC) drugs, and encouraging medical consultations, this health support also includes disseminating information from pharmacies and pharmacists.

It is very likely that the awareness of local residents regarding oral health will change and lead to dental consultations if community pharmacists actively engage in and support oral health. Our research has shown that this aligns with the dentists' expectations as well (*13*). However, oral health content has not been included in the pharmacy education curriculum as yet, and community pharmacists have been observed to lack confidence in supporting oral health (*14*). A study in Australia also corroborated on the need to provide oral health training to pharmacists (*15*). Therefore, in this study, we developed a two-step program: first, we developed a training program for community pharmacists to provide oral health support to the public. Second, community pharmacists working at health support pharmacies who had attended the training program implemented an oral health event intervention trial, and we assessed the blended learning training program's utility through a survey evaluating the resulting improvements and sustainability in their knowledge, explanatory ability, confidence, awareness, and behavioral changes regarding oral health support.

2. Materials and Methods

2.1. Study subjects

The target group for this study was pharmacists who had completed health support pharmacy training and were currently working at health support pharmacies (target pharmacists), who were recruited nationwide and provided consent for participating in the study. Self-administered questionnaires were used for conducting this research. During the study period, the target pharmacists also participated as interveners in the "intervention study on oral health events by pharmacists" (Figure 1). The Research Ethics Committee of the Faculty of Pharmacy, Keio University approved this study (Approval No. 230620-4).

2.2. Blended learning training on oral health support by pharmacists

A total of seven videos, each about 10 min long, were filmed at a shooting studio by Dr. Gotō, a dentist. The themes of the videos were as follows: 1) the importance of oral health, 2) key points of oral observation, 3) basic knowledge of prosthetics, 4) abnormal findings in the oral cavity, 5) mechanisms of eating and swallowing, 6) observation techniques of the Revised Oral Assessment Guide (ROAG), and 7) practical use of ROAG. The Japan Society for Oral Care supervised the videos to ensure academic validity and expertise. The videos were uploaded on Box cloud storage (Box.comTM) and only the target pharmacists were provided access. To ensure that the participants had viewed and studied the training videos, immediately after watching the videos, the participants were required to submit three keywords that had been embedded randomly at different points during the viewing. The keywords had to be in proper order. If the submission order of the keywords did not match, it was mandatory for the pharmacist to rewatch the video. In addition, a confirmation test was conducted immediately after the video was viewed, and the module was considered completed only if the desired level of achievement was reached. Keywords and confirmation tests were conducted and submitted using Google Forms.

The target pharmacists were subsequently required to attend a one-day on-site training at the Keio University Faculty of Pharmacy campus, where university faculty, dentists, and pharmacists conducted lectures on the following topics: 1) "The relationship between oral health and systemic diseases" (30 min, university faculty), 2) "Methods of oral health support by pharmacists" (40 min, pharmacist), 3) "How to hold events and considerations

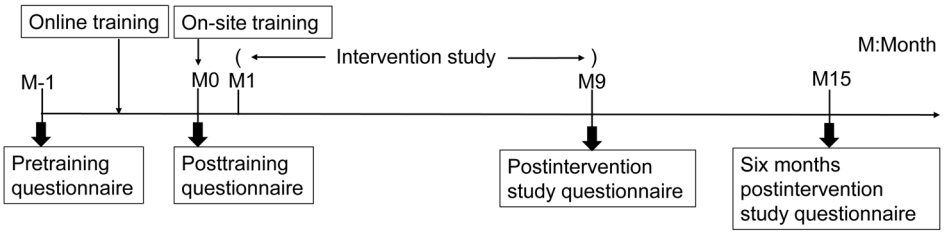

Figure 1. Study timeline and measurement schedule. This diagram illustrates the training phases and the timing of the questionnaire administration. Baseline measurement (M-1) was taken before the online and on-site training (M0). Follow-up questionnaires were administered 9 months (M9) and 15 months (M15) after M0.

for the hygiene environment" (30 min, university faculty), 4) "Practical training on oral observation and evaluation" (90 min, dentist).

2.3. Questionnaire survey

Following the online and the on-site training, an intervention study was conducted by the target pharmacists who agreed to participate. As demonstrated in Figure 1, the participants completed self-administered questionnaires four times throughout the study period: before the training (Month -1: M-1), after the online/on-site training (Month 0: M0), at the end of the intervention study (Month 9: M9), and six months after the intervention study (Month 15: M15). All self-administered questionnaires except for the one that had to be submitted immediately following the on-site training had to be requested and submitted *via* mail. Each participating target pharmacist had to complete self-administered questionnaires covering the following areas: 1) Attributes of the target pharmacists, 2) Effects of the training, 3) Knowledge, explanatory ability, and confidence regarding oral health support, 4) Availability of oral health-related products, and 5) Efforts related to the oral health field.

2.4. Statistical analysis

Friedman test was used for analyzing the changes in knowledge, explanatory ability, confidence, and awareness of pharmacists regarding oral health support. Repeated measures Analysis of Variance (ANOVA) was used for analyzing the availability of oral health-related products. To adjust for multiple comparisons, the Bonferroni method was used to make pairwise comparisons for significant differences. Comparison of the efforts taken related to the oral health field by pharmacists was done using the McNemar test. All significance levels were set at $\alpha = 0.05$ for two-sided tests. Missing values were excluded from each analysis. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) software, version 30 (International Business Machines (IBM) Corp., Armonk, NY, USA).

3. Results

3.1. Characteristics of the target pharmacists

Among a total of 39 participating target pharmacists, 25 pharmacists (response rate 64.1%) responded to the questionnaires up to M15. Their basic characteristics have been depicted in Table 1.

Majority of the participating target pharmacists were in their 30s. The gender distribution was almost equal. Majority of the participants had worked as pharmacists for a period of 10 to 15 years. Tochigi Prefecture was the workplace of most participants, followed by Tokyo and Kanagawa. Most worked in pharmacies located proximal to hospitals or clinics, and none worked in pharmacies located on hospital premises.

3.2. Evaluation of pharmacist training

We based the evaluation of the pharmacist training on the perceived growth of the target pharmacists immediately following the completion of both the online and on-site training. All pharmacists rated their knowledge, explanatory ability, and confidence regarding oral health support as "increased" or "somewhat increased."

3.3. Sustained effects on knowledge, explanatory ability, and confidence after pharmacist training

When responding to the M-1 point, four target pharmacists (16.7%) believed that they could provide "appropriate or somewhat appropriate knowledge" when consulted about oral troubles or oral care. This number significantly increased to 14 pharmacists (58.3%) when responding to M9 and 17 pharmacists (70.8%) when responding to M15 (Figure 2A). With regards to explanatory ability, two pharmacists (8.3%), thought they could "explain well or fairly well" at M-1. This number significantly increased to 13 pharmacists (54.2%) at M9 and M15 (Figure 2B). With regards to confidence in providing oral health support, two pharmacists (8.3%) responded "confident or somewhat confident" at M-1, and this number significantly increased to 10 pharmacists (41.7%) at M9 and 14 pharmacists (58.3%) at M15 (Figure 2C).

Table 1. Characteristics of the participants (*n* = 25)

	n (%)
Age	
30–39	21 (84.0)
40–49	1 (4.0)
50–59	2 (8.0)
60+	1 (4.0)
Sex	
Male	11 (44.0)
Female	14 (56.0)
Pharmacist career (years)	
5–9	9 (36.0)
10–14	11 (44.0)
15–19	1 (4.0)
20+	4 (16.0)
Work location (Prefecture)	
Tokyo	3 (12.0)
Tochigi	13 (52.0)
Kanagawa	3 (12.0)
Miyagi	4 (16.0)
Iwate	1 (4.0)
Saitama	1 (4.0)
Pharmacy setting	
Near a hospital/clinic	23 (92.0)
Community-based	2 (8.0)

3.4. Changes in the availability of oral health products

As demonstrated in Figure 3, the response to the point regarding the availability of oral health-related products, excluding OTC drugs, was 89 types at M-1, and the number increased to 107 types at M9 and 117 types at M15. Thus, a significant increase was observed at M15 compared to M-1 ($P = 0.014$).

3.5. Changes in efforts and awareness related to oral health

For comprehending the presence or absence of efforts related to the oral health field, we compared M-1 and M15, as the intervention study itself was considered an effort. At M-1, the number of pharmacists who were already engaged in efforts related to the oral health field was 8 (32.0%), which significantly increased to 20 pharmacists (80%) at M15 ($P < 0.01$) (Figure 4). Furthermore, when responding to the question of whether pharmacists should actively engage in oral health, at M-1, 19 pharmacists (79.2%) responded "agree or somewhat agree." This number increased to 23 pharmacists (95.8%) at M9, and 24 pharmacists at M15 (Figure 5). The remaining one pharmacist did not respond to the questionnaire at M15.

3.6. Changes in knowledge, explanatory ability, and confidence based on the attributes of target pharmacists

With regards to the comparisons regarding changes in knowledge, explanatory ability, and confidence based on gender and whether there were any efforts before the training, no differences were noted (data not shown). The bias was too large for other attributes and comparison was not possible.

4. Discussion

The training conducted in this study enabled all

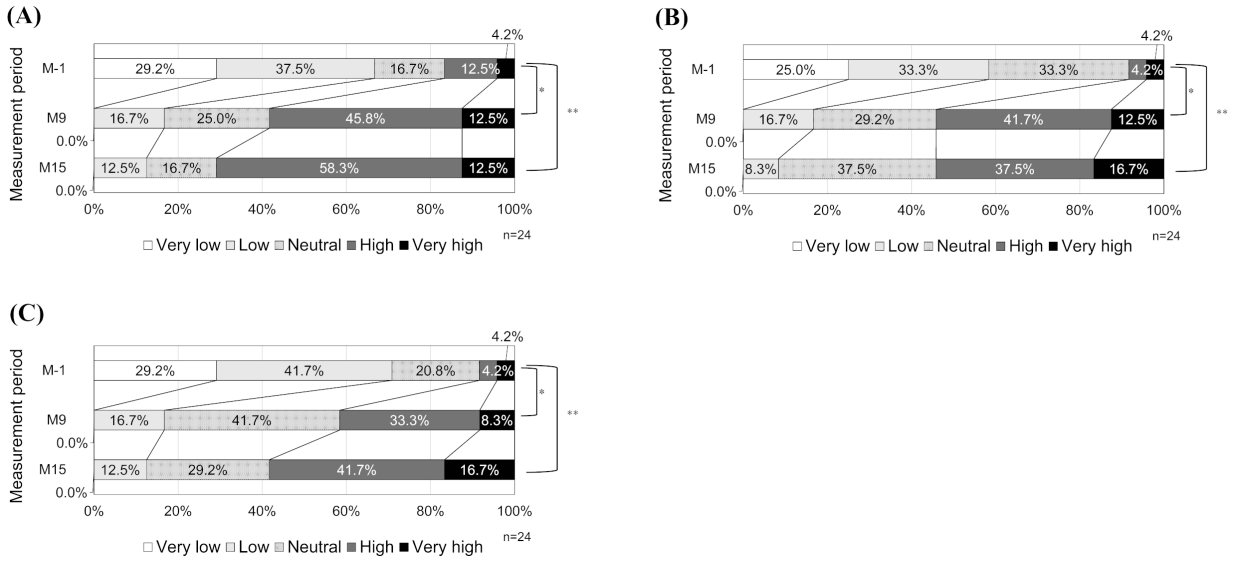

Figure 2. Training effectiveness: longitudinal changes in self-reported knowledge, explanation ability, and confidence rating. Data demonstrates the distribution of scores (5-point scale) at baseline (M-1), 9 months (M9), and 15 months (M15). All three items exhibit a significant overall difference across the time points (Friedman test, $P < 0.01$). Significance levels for multiple comparisons have been compared to M-1: (**A**) Knowledge Level: M9 ($P = 0.003$), M15 ($P < 0.001$); (**B**) Explanation Ability: M9 ($P = 0.001$), M15 ($P < 0.001$); (**C**) Confidence Rating: M9 ($P = 0.003$), M15 ($P < 0.001$). *$P < 0.05$; **$P < 0.001$.

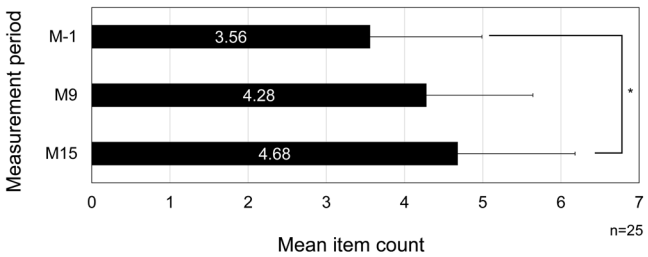

Figure 3. Changes in the total number of oral care items handled by pharmacists. Data have been presented as mean ± SE (Standard Error) and analyzed using repeated measures ANOVA. The overall effect of time (M-1, M9, M15) was statistically significant ($P = 0.003$). Post-hoc Bonferroni-corrected comparison demonstrated a significant increase between the baseline (M-1) and M15 ($P = 0.014$).

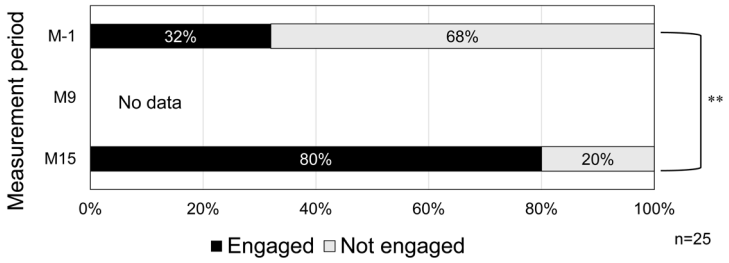

Figure 4. Pharmacists' engagement in oral health support before and after intervention. The figure depicts the percentage of pharmacists providing an affirmative response to personal efforts regarding oral health. Data represent M-1 and M15. M9 data was omitted as study participation itself constituted the effort during that period. The increase in engagement was highly significant (McNemar test, $P < 0.01$).

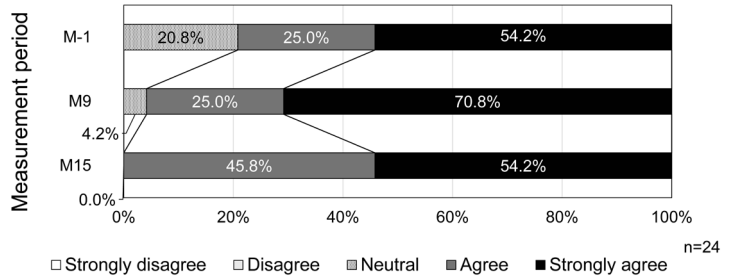

Figure 5. Pharmacists' attitudes toward proactive involvement in oral health. The figure displays the distribution of responses (5-point scale) to the question regarding proactive involvement in oral health at M-1, M9, and M15. No statistically significant difference was noted across the three time points (Friedman test, $P > 0.05$).

pharmacists to enhance their knowledge, explanatory abilities, and confidence with regards to oral health support, indicating that the challenges faced by the pharmacists in the field of oral health, as previously reported by us (*14*), can be resolved. Furthermore, the abilities acquired through this training were found to persist even 15 months after the training. Besides, an increase in the types of oral health-related products and the number of pharmacists involved in oral health support indicated enhanced health support capabilities with respect to the psychological aspects to respond to consultations from local residents and also through the provision of materials and services. To the best of our knowledge, this study is the first to quantitatively evaluate the utility of an oral health training program for community pharmacists, in terms of improved and sustained knowledge and behavior change among participants. Such training programs are likely to foster the oral care knowledge and skills of pharmacists working at health support pharmacies nationwide.

Similar to our previous study the percentage of pharmacists who believed that they had the knowledge, explanatory ability, and confidence in oral health support prior to participating in the training was around 10% (*14*). However, the items in which pharmacists exhibited progress immediately after completing the training, exhibited a significant growth almost 9 to 15 months after the training compared to the time period before that, which indicated that sustained use of the acquired knowledge promoted further retention. A previously conducted study by Man *et al*. (*16*), systematically investigated the current state of oral hygiene education interventions for pharmacists and pharmacy staff; however, the effects of the interventions, even though visible, were not quantitatively evaluated. The quantitative and longitudinal demonstration of the utility of the blended learning (online and on-site training sessions) in this study provides a basis for the broader application of similar training programs in the future. Additionally, this training is considered universally applicable to all pharmacists considering the absence of differences in changes in these items based on the presence or absence of pharmacists' daily oral health support efforts or the availability of oral health-related products in pharmacies.

The availability of oral health–related products continued to increase even 15 months after the training. More than 90% of the participating pharmacies were located near hospitals/clinics; therefore, unlike drug stores, only a few pharmacies stocked a wide range of dental hygiene materials. This increase in the stock of the oral health-related products indicates that the pharmacists not only comprehended the significance of oral hygiene during the training, but believed and realized its utility while supporting the oral health of local residents in the intervention study conducted after the training. This is evident from the increase in the proportion of the pharmacists practicing oral health support from 32% before the training to 80% at 15 months after the training, continuing some form of oral health support even after

the intervention study. This figure of 80% roughly matches the proportion of pharmacists who, before attending the training, had believed that pharmacists must provide oral health support. Remaining 20% of the pharmacists who were skeptical about getting involved in oral health support prior to attending the training also recognized the importance of oral health support 15 months later, indicating that even pharmacists who were not engaged in oral health support by the end of this study could eventually begin to do so in the future.

We have previously reported that providing oral health checks and information on oral self-care in pharmacies can benefit the oral health of local residents (*13*). Training pharmacists to have knowledge and skills in oral care and who consciously intervene with local residents during the course of their daily work can help in advancing oral health support for the local residents in the future.

This study does have some limitations. All participating pharmacists were those who had already completed health support pharmacy training and were proactively supporting the health of local residents, which was evident from their willingness to participate in the intervention study. The effects of this training might therefore be limited to pharmacists with an inherently high level of awareness and motivation. Additionally, as a part of this study, all participating pharmacists completed an intervention study after completing the training, following which, their subsequent status and sustainability were examined, making it impossible to separate the effects of the training from the effects of participating in the intervention study. Therefore, it is necessary to verify the usefulness and sustainability of the training with different cohorts of community pharmacists when we conduct training sessions in the future.

Furthermore, the reliance on self-reported questionnaires for primary outcome measures is an important consideration, as these measures are inherently susceptible to social desirability bias. Participating pharmacists may have subconsciously over-reported their improvements to align with the perceived objectives of the training. Although the study did not employ objective performance metrics such as proficiency tests, the previously discussed increases in both oral health-related products and the proportion of pharmacists practicing oral health support are considered to complement these subjective data. Future research should incorporate more objective metrics to further validate the impact of this blended learning program.

In conclusion, this study developed an oral health blended learning program for pharmacists at health support pharmacies, which can be instrumental in promoting oral health support in pharmacies throughout Japan. Such training programs can contribute to maintaining oral health among local residents, preventing oral frailty, and reducing mortality rates.

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Conflict of Interest: The authors have no conflicts of interest to disclose.

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**Address correspondence to:*
Katsunori Yamaura, Division of Social Pharmacy, Center for Social Pharmacy and Pharmaceutical Sciences, Faculty of Pharmacy, Keio University, 1-5-30 Shibakoen, Minato-ku, Tokyo 105-8512, Japan.
E-mail: yamaura-kt@keio.jp

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