APPLICATION OF AN INTERACTIVE MULTI-MODALITY (IMM) FOR SELF-MANAGEMENT SUPPORT AMONG THAI PATIENTS WITH TYPE-2 DIABETES: A PRELIMINARY INTERVENTION STUDY

Suwaree Wongrochananan[1, *], Wiroj Jiamjarasrangsi[2], Arunya Tuicomepee[3], Marut Buranarach[4]

[1]Department of Health, Ministry of Public Health, Nonthaburi 11000, Thailand
[2]Faculty of Medicine, Chulalongkorn University, Bangkok, 10330, Thailand
[3]Faculty of Psychology, Chulalongkorn University, Bangkok, 10330, Thailand
[4]National Electronics and Computer Technology Center (NECTEC), Thailand Science Park, Pathumthani 12120, Thailand

ABSTRACT: The purpose of this preliminary study was to develop and apply the Interactive Multi-Modality (IMM) intervention to self-management supports among Thai patients with type-2 diabetes. The IMM intervention included website, email, and SMS. Four main functions of IMM were self-regulation, self-monitoring and assessment, social support, and reminder system. Additionally, the IMM intervention included four knowledge: Food/nutrition, Exercise, Emotion and General health care. Participants were 78 patients with type 2 diabetes. They were recruited and selected with the set criterions that were HbA1c >7.0%, accessible via mobile telephone and non-influential diseases for compliance with this study. Results showed that IMM intervention played an important role in supporting diabetic patients' efforts to follow self-management plans, especially to improve their self-care about food consumption. The IMM intervention helped the patients in getting support from health care providers and peers to stay well. We purpose to deliver the technology into quality health care system in the near future.

Keywords: Interactive multi-modalities (IMM), type-2 diabetes, self- management support

INTRODUCTION

Type-2 diabetes is significant concerns in Asia and worldwide [1, 2]. In this regard, self-management support is recognized as an important component in improving quality of healthcare among providers and patients [3, 4]. Empirical studies have been documented that interactive behavioral change technology (IBCT) has been assisted to support self-management behavior of the individual patient in many countries [5, 6]. The IBCT assists both patients and health care providers in health and self-care needs. It also supports patients' efforts to make behavior changes by promoting health and effective self-care, and moreover it enhances communication between patients and potential supporters for their disease management [7]. However, most of the literature has a conclusion based on studying of the ICBT in a western context. Experience of ICBT responses may vary along social and cultural contexts.

Although some forms of IBCT for diabetic care have been implemented in Thailand, an empirical study in relation to the use of the Interactive multi-modalities (IMM) and responses between health providers and patients who engage in the IBCT is still limited. The IMM can be incorporated into IBCT to facilitate self-care management in diabetic patients.

IMM consisted of website, email, and Short Message Service (SMS). Regarding a choice of selected modalities, website has great potential in terms of its convenience; however, it has difficulty retaining users for follow up [6]. To minimize loss of follow up, emails are added to be reminders for enhancing and sustaining self-management. In addition, SMS is included to strengthen the reminder. Accordingly, this preliminary study aimed to develop and apply the IMM which incorporated into IBCT to facilitate self-care management in Thai patients with type-2 diabetes.

METHODS

Research design: This present study was a part of the cluster-randomized controlled trial study that aims for examining the effectiveness of the developed IMM intervention among Thai patients with type 2 diabetes. This study employed qualitative methods to describe process of the

[*] *Correspondence to: Suwaree Wongrochananan*
E-mail: w.suwaree@gmail.com

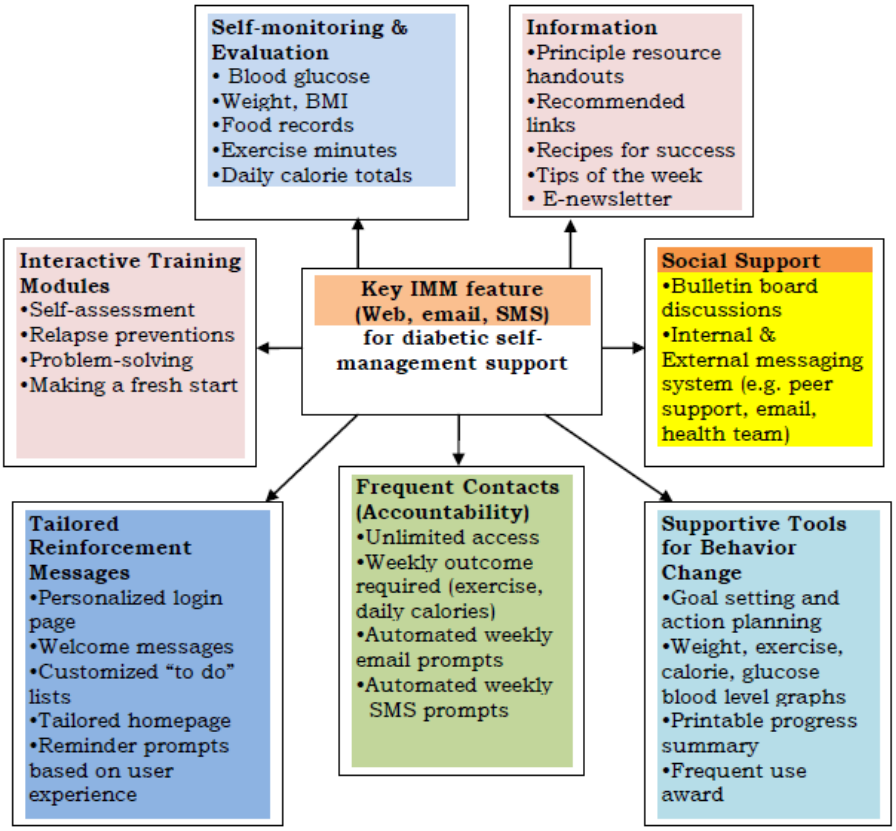


Figure 1 Key interactive feature

development of IMM intervention and to preliminary study of its application.

Participants and settings: Thai patients with type 2 diabetes were selected purposively from two settings. One setting is the Faculties of Chulalongkorn University, and the other is general clinics of King Chulalongkorn Memorial Hospital. Inclusion criteria were: able to read and write Thai and having Internet access, aged 18 years or older, having been diagnosed as type 2 diabetes for at least 6 months (either insulin or non-insulin-treated) with current glycosylated hemoglobin (HbA1c) >7.0%, accessible via mobile telephone. Exclusion criteria were : having any significant diseases that may affect the outcome and compliance with this study; a heart condition, chest pain during periods of activity , taking any weight loss medication, being pregnant, expecting to be pregnant and/or lactating, major psychiatric diseases. The patients were recruited by using several approaches (e.g., advertisements, press conference, public announcements, leaflets, roll-ups). Finally, seventy-eight patients with type 2 diabetes agreed to participate in the study.

Instruments: included the IMM intervention which was developed for this study, and a set of questionnaires. The developed IMM intervention and questionnaire were applying to the participants througha public website (http://www.google.co.th). Questionnaires asked about socio-demographic characteristics and self-management behaviors which were collected by an opened questionnaire that included nutrition, physical activity, emotion and self-monitoring complication or general health care. Ethical approval was obtained from the Institutional Review Board, Faculty of Medicine, Chulalongkorn University (IRB No. 032/53).

Phase I: A development of IMM intervention

This phase aimed to develop a web-based program for diabetic patients. The program aims to encourage diabetic self-management skills, improve self-efficacy, promote social support and reinforce existing self-management behavior of the patients. The constructive concept for development of the interactive modality is illustrated in Figure 1. Details of IMM intervention development were described below.

First, the interactive technology and its contents were developed in consultation with experts in diabetes and behavioral sciences. The technology was developed based on a personal patient's empowerment as a vital strategy; therefore, the

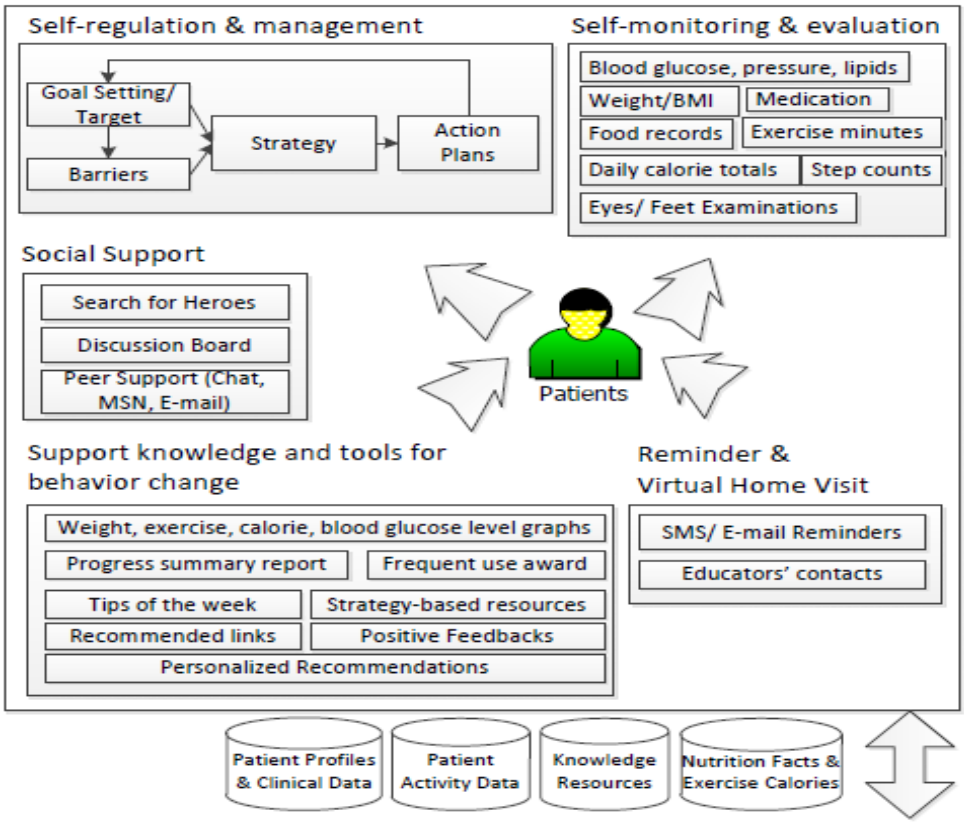


Figure 2 Functions of the patient's self-management support

self-regulation theory [8] was integrated into the process of the development. The theory consists of goal setting, active goal pursuit, and goal attainment and maintenance [9]. The interactive technology consisted of website as a core function, and email and SMS were added to be reminders in the system. These components were performed as guidelines to provide tailor-made skills, to encourage diabetics to set their personal goals, to find individual's barriers, to make action plans, to carry out the plans, and to sustain self-management behavior. These behavioral regulations were motivated by two main stimulants including internal and external motivations. The internal stimulus was within oneself and the other was from external motivating force such as behavioral intervention-the diabetes technology.

Second, the website was designed in consultation with an expert in information technology from the National Electronics and Computer Technology Center (NECTEC) of Thailand. The portal of the technology was a website which contained features and options to support the users through the self-management process. For example, once logging into the website, the patient was welcomed by an individually tailored welcome message, which included summary of personal health data. Subsequently, the patient was provided with a set of goals, barriers, and strategies to achieve the goals. Then each patient could create an action plan to accomplish the goals. In order to sustain behaviors that lead to an improvement, the reminders (email and SMS) were sent to the patients as an encouragement.

Third, external multi-disciplinary commentators including two computer system and software experts, three health providers (a physician, a nurse), and an expert in the art of communication were invited to share ideas relating to the website. Subsequently, two diabetic volunteers were visited to test it. Furthermore, ten participants who visited the website during an early trial period were surveyed. Their opinions were grouped to 3 categories i.e., feature, content suitability, and function of the interactive website.

Finally, the developed IMM consisted of 4 main functions that were self-regulation, self-monitoring and assessment, social support, and reminder system. In addition, the diabetic knowledge included 4 categories which were food/nutrition, exercise, emotion, and general health care. The functional service system of the portal website was summarized in Figure 2 and briefly described as follows:



Figure 3 An example of knowledge resources on the main web page



Figure 4 Series of user interface for patients creating action plans

1) Self-regulation and management

When patients logged on to the website: they set their targets and plans such as food control—decreasing carbohydrate or sugar and increasing fibrous food, exercises, weight control, etc. After setting targets, the system then showed a list of possible barriers or obstacles to reach the selected targets. Then patients were directed to determine their barriers. Subsequently, recommended strategies were displayed to aid diabetics to overcome their barriers. Each recommended strategy was linked to knowledge resources which were classified into such 4 categories. Calendar or daily action plan was also provided for patients to create personal self-care plan. The calendar plan was connected to IMM reminders (email and SMS) in order to notify and encourage each individual act. (Figure 3 & 4)

2) Self-monitoring and evaluation

Health records for such bio-markers as — weight, BMI, blood pressure, HbA1c, fasting blood sugar and serum lipid levels could be created by patients. They could also record their daily activities, e.g. daily food consumption and exercise minutes. The system provided calculation tools for balancing energy—food intakes and physical activities. In order to support self-monitoring and evaluation, personal health data were summarized to assist monitoring progress of self-care. Furthermore, diabetics could record and see reports of some major activities and milestones, e.g. changing targets, achieving the targets, visiting doctors, etc. (Figure 5)

3) Social Support

Since social support is one of the external motivations to help patients accomplish their goals,

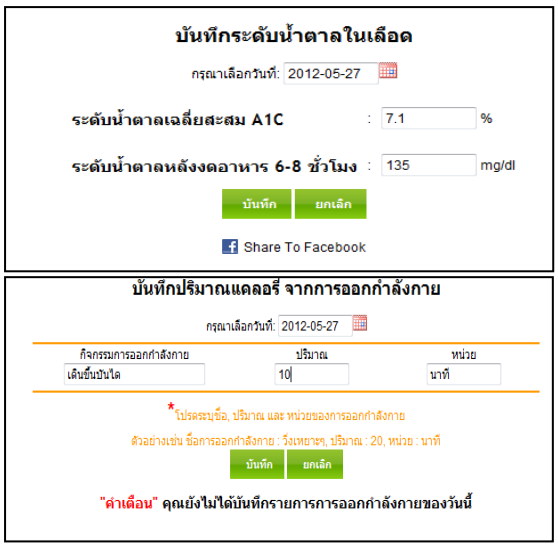


Figure 5 Examples of patient data for self-monitoring and evaluation

the web board and private mailbox were provided for peer support and health care advice. In addition, patients with good performance records were automatically promoted as "heroes", and they were presented to other patients. (Figure 6)

4) Reminder and Virtual Home Visit

The reminder system, including e-mail and SMS, was activated to encourage and remind patients to follow their action plans. In addition, health care providers and educators could monitor and review each patient's record to assess their performances; then, they could give personalized recommendation or advice for each patient through e-mail and SMS (Figure 7).

Phase II: An application of IMM intervention

This phase aimed to apply the IMM to Thai patients with type 2 diabetes for improving their self-management behavior.

First, an implementation system was established at the King Chulalongkorn Memorial Hospital, Bangkok. The system including hardware, software, and people-ware was set to process during the period of this study. A researcher acted as the administrator and educator of the system. A confidential user name and a login password were sent to each participant. Then, the participants were assigned to complete a set of on-line questionnaires. Details of procedure are described as follows:

1) Electronic-coach (e-coach) for self-management support

IMM system provided diabetes knowledge, communication, and social support via the website as e-coach that suggested a tailored strategy for each patient throughout the intervention period. The interactive modalities provided tips for overcoming barriers and reaching their goals. In fact, the participants and health providers can up-load and down-load graphical feedback or feed-forward of patterns of blood glucose level. In addition, auto-email and SMS were sent to remind participants who did not continue accessing the website and also prompt them to act as one plan.

2) Risk perception and the health problem representation

After the participants logged on to the application page of the website, they were asked to record detailed information such as changes in diet or exercise, hypoglycemic events, and other factors that might influence the blood glucose level in the memo box.

3) Encouraging the individual to set personal goals

Participants chose one or more behavioral change goals from set of goal setting options (such as



Figure 6 examples of social support

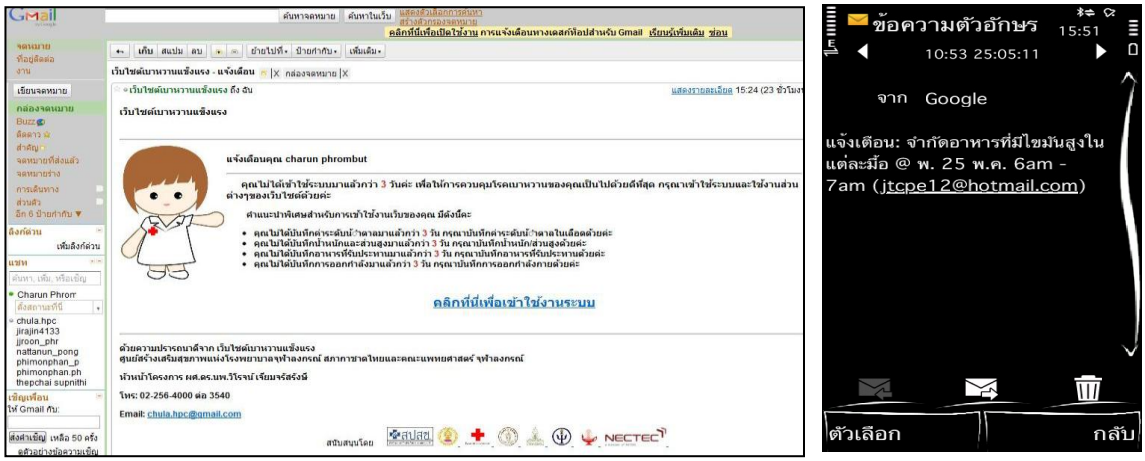


Figure 7 Examples of reminders "email and SMS"

weight loss goal, activity goal, and dietary counting etc) provided by the system. Possible barriers for achieving the chosen goal(s) were then displayed, and the participants chose among these barriers that they expected to encounter. Consequently, list of relevant coping strategies were provided, and a 'More Information' icon was created for each strategy. At this step, participants chose whatever suitable for their individual goals.

4) Building an action plan

After the patients reviewed their barriers and strategies, the interactive website guided them in the action planning to obtain the target by specifying the detail about the activity (what to do, when, where, and how), and time frame for goal attainment.

5) Social support

The social communication and peer support was created on bulletin board as behavioral motivation. The patients were asked to report their calorie counting and physical activities on the web page.

6) Monitoring and evaluation

The program administrator logged on to the system and sent appropriate recommendations (based on the patients' profile) to each patient in the intervention group every 2 weeks. Any additional specific problems about self-management or lifestyle changes were referred to the educators such as nutritionist, exercise specialist, or physician. In each individual, the program was also responded with a feedback answer, guided by the self-regulation theory. In response to the patients' questions, advice was given according to their contents (e.g. adjustment of diet or increase

Table 1 Demographic and characteristics of participants

Characteristics	Number (%) / Mean (SD)
Gender (78)*	
Female	34(43.6%)
Male	44(56.4%)
Age (yr) (78)	53.6 (8.6)
Marital status (64)	
Married	49 (76.6%)
Single /divorce	15 (23.4%)
Education (64)	
<Bachelor degree	13 (20.3%)
Bachelor degree	27 (42.2%)
>Bachelor degree	24 (37.5%)
Occupation (64)	
Labour	8 (12.5%)
Company/employee	4 (6.2%)
Government/state enterprise officer	35 (54.7%)
Retired/house wife	17 (26.6%)
Income (59) (baht/month)	54,100(60419.0)
Duration of DM (yr) (62)	7.1 (6.1)
DM medication (64)	
Oral	55 (85.9%)
Insulin	4 (6.2%)
None	5 (7.8%)

* Numbers of participants were from physical examinations at baseline.

Table 2 Behavioral change and web- use information

Behavioral variables (n)	Baseline Mean (SD)	3rd month Mean (SD)	*p-value*
Self-care (26)*			
Food/nutrition	13.85 (4.37)	16.08 (3.97)	0.03
Exercise	5.92 (3.73)	6.62 (4.24)	>0.05
Self- monitoring	28.00 (13.44)	32.35 (10.34)	0.01
Drug adherence	10.85 (4.31)	10.92 (4.32)	>0.05
Web use (70)			
Every 3 days		9 (12.9 %)	
Every 7 days		8 (11.4 %)	
Every 14 days		11 (15.7 %)	
Every 30 days		3 (4.3 %)	
Over 30 days		39 (55.7 %)	

*****Numbers of participants were from questionnaires at baseline and the 3rd month.

physical activity level). Feedback was also given visually in colors, tables and graphics.

Data analysis

The qualitative data on self-management behaviors that were obtained from open ended questionnaires and interview was analyzed. The responses from the questionnaires and transcription of the interview tapes were analyzed using content analysis. Trustworthiness of the analysis such as validity of the findings, interpretation, and summary from data were achieved through external audit conducted by experts on diabetes and expert on qualitative research.

RESULTS

Seventy-eight Thai patients responded to the IMM intervention during 3 months. These included 34 females and 44 males. Their age varied from 31 to 72 years old. The diabetic duration was 7.1 years on average. Most participants (85.9%) used oral anti-diabetic medication (Table 1). Participants were monitored for their web use. The number of logins varied from every 3-day to over 30-day. In summary, the participants demonstrated their behavior changes related to food consumption, exercise, self-monitoring for complications, and drug adherence (Table 2).

There were been changes of such behaviors and feedback of IMM system as following.

1. Self-management Behavior

The data revealed 4 themes as follows:

a. Food/ Nutrition

Most participants gained awareness and changed their eating habits by controlling carbohydrate and sugar intakes. They recorded their consumption on the daily energy balance sheet such as

> *"I always ate high carbohydrate and I liked sweet desserts. Now I eat less, just to get by"* (male, aged 61)

> *"I am now stricter and I record food intake too"* (male, aged 58)

In addition, the participants were better aware of nutritional label when buying food products:

> *"Now, I get used to reading nutritional labels when buying food products"* (male, aged 55)

b. Exercise

Participants demonstrated transformation from knowing to acting and they integrated exercise/physical activity in their daily life. For instance, the participants stated that

> "*I knew that exercise is beneficial but I did not take it; Now, I do the activities that are really good for health"* (female, aged 31)

> *"Most evenings, I walk home; I do not drive my car"* (female, aged 56)

> *"I have set a goal to exercise 30 minutes per day, 5 days per week*" (male, aged 52)

In addition, they set to walk for decreasing HbA1c as in words

> *"I have set a goal to walk at least 10,000 steps per day in order to decrease my HbA1c to lower than 7%"* (male, aged 55)

c. Emotion

Although participants did not express their feelings regarding self care management, some of them reported their feeling of job stress and ate a lot more. For instance, he said that

> *"Although I can diet, I cannot control stress. There were many meetings and I was stressed. So, I ate more sweet desserts*" (male, aged 44)

d. General health care

Participants demonstrated self-care behaviors such as monitoring their diabetic complications (e.g. hypo- and hyper-glycemia, skin care, foot care, and taking medication). For example the participants stated that

> "*I also be more conscious about skin care"* (male, aged 66)

> *"Previously, I did not eat every meal because I misunderstood that would help decrease my blood sugar. Presently, I have improved my eating; I eat proper food at proper time*" (male, aged 45).

Regarding diabetic medications, some participants were interested in using Thai herbs as the alternative treatment. They thought that if they take drug for longtime, it may cause renal problems.

2. Feedback of IMM system

Furthermore, feedback data on IMM intervention was acquired from the interview. Some participants commented that the website was rather complicated to use, especially concerning calorie recording function. Additionally, network was not easy to access as well as technical errors. However, users accepted that the project is very beneficial for them. These are shown as follows:

> *"It is difficult to record nutrition intake data into the program since I always forget to do so and it is hard to count food calories"* (female, aged 38)

> *"The data on the website is beneficial for health; however, new or update information should be labeled and made it accessible by simply clicking on it"* (male, aged 62)

> *"This project is very beneficial to me but the computer system is less than complete"* (male, aged 50)

> *"I often cannot log into the website. So, my walking data is not recorded, I feel very bored"* (female, aged 54)

> *"When I inputted my food intake on the program, it immediately showed 'error' and also my previous information is lost. I wonder why"* (male, aged 60)

DISCUSSION AND CONCLUSION

The developed IMM intervention integrates multiple interactive technologies and can be applied successfully to patients with type-2 diabetes. The salient improvements on self-management behavior were demonstrated by the patients. One possible reason is that the designed IMM intervention is based on the self-regulation theory, especially the website. The patients benefit from setting their realistic goals, obtaining goals, and maintaining the desired behaviors. Also the reminders (email and SMS) make to more alert on the individual's daily plan. Another reason would be social support in regard to their food consumption behaviors. The IMM intervention helps patients in getting support from health care providers and peers to stay well.

Interestingly, the patients in this study provided their rich comments on difficulties using the web-based program. Some addressed concerns of attractiveness and user-friendliness of the web-based program. One possible reason for such difficulties and concerns would be mean aged of this population as of 53.59 (SD = 8.64) years old. Most Thai diabetics are currently elderly with no or limited experience in the internet use, while promising young people are extremely rare to be diabetics. However, the patients interest the IMM intervention in self-management support as an instrument for improving health by themselves. The IMM will be expected to be their virtual clinics that patients can approach health advices conveniently. A user-tailoring, web-based instrument would be the best to add value to the IMM intervention.

In summary, the IMM intervention as a form of IBCT to facilitate self- management in diabetic patients is promising in producing good outcome and may be scalable as a low-cost method. Further research is needed to document its efficacy and the intervention costs.

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