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ORIGINAL RESEARCH PAPER

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Feasibility study of automated interactive voice response telephone calls with community health nurse follow-up to improve glycaemic control in patients with type 2 diabetes

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Abstract

Background: Thailand has a shortage of community health nurses for supporting the self-management of type 2 diabetes, which is prevalent and poorly controlled.

Aim: This study examined the feasibility and acceptability of a self-care assistance programme for poorly controlled type 2 diabetes mellitus. The SukapapNet programme consisted of automated interactive voice response calls to patients and automated follow-up email notifications to their nurses.

Design: Single-arm pre-post trial.

Methods: Six nurses and 35 type 2 diabetes patients were recruited from primary care settings in suburban provinces in Thailand. The study was conducted from June 2017 to November 2017. We assessed patients before and after 12 weeks of the SukapapNet intervention.

Results: Mean glycated haemoglobin decreased by 0.9%. Patients reported reduced carbohydrate consumption, increased physical activity, increased medication adherence, improved sleep quality, and more frequent foot care. Patients and nurses both recommended using the intervention, although nurses expressed concerns regarding increased workload.

Conclusions: The study programme could improve outcomes in Thai type 2 diabetes patients. Further study of the impact of technology upon nurses' workload is warranted.

KEYWORDS

community, glycated haemoglobin, mobile health, nurse, type 2 diabetes

Trial registration: This trial is registered at clinicaltrials.gov under NCT03078764.

SUMMARY STATEMENT

What is already known about this topic?

- Prevalence of type 2 diabetes is increasing in Thailand, and nurses who play an important role in health care at the community level are limited.
- Mobile health strategies including short message service, automated telephonic monitoring, and internet-based education have been successfully applied in Thailand with prenatal care, depression, Parkinson disease, cardiac rehabilitation, and diabetes.
- Although mobile health is a promising way to bridge gaps in managing type 2 diabetes, an effect of automated mobile health with nurse follow-up has never been investigated in primary care settings.

What this paper adds?

- Automated interactive voice response monitoring of diabetes patients with emailed updates to nurses is acceptable to Thai patients with poorly controlled type 2 diabetes.
- Mobile health strategies could also improve Thai nurses' ability to help diabetes patients with glycaemic control.
- To reduce burden for nurses, summaries of patients' responses should be emailed on a less-than-daily basis.

The implications of this paper:

- This study contributes to the knowledge of how mobile health strategies could help Thai patients with type 2 diabetes achieve glycaemic control and increase nurses' engagement with these patients.
- Innovative use of automated interactive voice response with feedback to community health nurses should be further developed in Thailand.
- Future research should investigate a mobile health benefit to diabetes glycaemic control through a large-scale randomized controlled trial.

1 | INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a complex and escalating health problem in Thailand, where prevalence increased from 0.97% to 1.23% (or by 28%) between 2011 and 2015 (Ministry of Public Health, 2016). Good glycaemic control reduces risks for microvascular and macrovascular complications (Fowler, 2011; UK Prospective Diabetes Study (UKPDS) Group, 1998). Thailand's national health policy directly encourages the use of interventions to reduce blood glucose in patients, and most efforts focus on individual and group diabetes and self-care education (Mekwiwatanawong, Hanucharurnkul, Piaseu, & Nityasuddhi, 2013; Ounnapiruk, Wirojratana, Meehatchai, & Turale, 2014; Wattanakorn, Deenan, Puapan, & Schneider, 2013). Although some of these programmes are promising, they are time-intensive and require extensive nursing effort to longitudinally monitor and tailor adjustments. Such approaches are probably quite unrealistic to implement widely, given that there are fewer than two nurses per 1,000 Thais (Ministry of Public Health, 2017), with an even lower ratio in primary care settings. Even if some Thai T2DM patients have access to nursing resources, many do not receive education or regular follow-up owing to barriers such as competing time demands and transportation difficulties.

Mobile health (mHealth) with automated interactive voice response (IVR) could be used to provide better monitoring and support to diabetes patients, even in the context of limited resources. Using IVR, patients can regularly undergo assessments and receive self-management messages via phone. Nurses and other support persons can receive automated alerts about patients' IVR-entered data. Related mHealth-based IVR systems have been implemented for chronic conditions in the United States (Aikens, Zivin, Trivedi, & Piette, 2014; Pfeiffer et al., 2015) and successfully pilot tested in four low- and middle-income countries in Latin America (Piette et al., 2016).

A similar programme could likewise be helpful in Thailand, given that other digital health communication strategies (eg, short message service [SMS] and emails) have been used to educate patients (McCann, Songprakun, & Stephenson, 2015; Wongrochananan, Tuicomepee, Buranarach, & Jiamjarasrangsi, 2015). In fact, IVR could serve a unique role in this context, particularly for patients with low literacy, insufficient access to internet-enabled phones, or a greater need for self-care messages. These ideas were supported by a study using IVR to enhance self-management for Thai T2DM patients (Kulnawan et al., 2011). To our knowledge, IVR-based monitoring has never been formally evaluated in primary care settings where Thai nurses are the primary providers, nor in terms of its impact on glycated haemoglobin (HbA_{1c}) as goal among patients with T2DM. We therefore designed the SukapapNet programme to address Thailand's expanding shortages of personnel and resources for diabetes management.

The PRECEDE-PROCEED model (Green & Kreuter, 2005) guided our programme development and selection of measures. According to this model, health behaviour change interventions should address predisposing (intrapersonal variables), enabling (personal predisposition variables that encourage action), and reinforcing factors (consequences that sustain new behaviours such as rewards and/or symptom relief). In this study, predisposing factors included patients' health literacy, self-efficacy for self-managing their diabetes, hypoglycaemic symptoms, and psychological distress (depressive symptoms and diabetes-specific distress). Satisfaction with the IVR service availability and acceptability were two enabling factors. Finally, we considered positive social and personal reinforcement (eg, from improvements in physical well-being and psychological distress) as two reinforcing factors. The model also recommends process evaluation of how intervention is conducted. We summarized this in subsequent report covering call completion, week-to-week trends in self-management behaviours, and nursing interventions as measured through qualitative exit interviews.

The primary study outcome was HbA_{1c} and fasting blood glucose (FBG). Potential mediating behavioural variables such as adherence to anti-hyperglycaemic medication and maintenance of healthy

lifestyle behaviours (physical activity, low carbohydrate consumption, adequate sleep, and appropriate foot care) were also evaluated.

2 | METHODS

2.1 | Aims

The study aimed to evaluate the feasibility and potential efficacy of the SukapapNet programme for improving glycaemic control and self-management among Thai diabetes patients. We also evaluated user satisfaction with the programme from the perspectives of both nurses and patients.

2.2 | Design

We conducted a single-arm, 12-week trial with assessments at baseline and immediate postintervention.

2.3 | Participants

We recruited outpatients from six primary care settings located in suburban Thai provinces who met the following criteria: ≥20 years of age, with poorly glycaemic control as indicated by $HbA_{1c} \geq 7.5\%$, current prescription for oral anti-hyperglycaemic medication, and access to and ability to use a touch-tone telephone. Six community health nurses were recruited from the primary care settings where these patients received care; each was responsible for six patients participating in the programme. All nurses were already working in a noncommunicable disease clinic, had access to email, and possessed a mobile telephone. Because this study was designed to simply pilot test the intervention in terms of acceptability and potential effect size, we chose a sample size of 36 patients and six nurses based primarily upon logistical considerations rather than estimation of sample size needed for hypothesis testing.

We screened 74 T2DM patients for eligibility. Of these, 30 did not meet HbA_{1c} entry criteria, and eight declined (82% of those eligible), leaving 36 patients (six per nurse). One patient withdrew from the study (owing to acute limb oedema unrelated to study participation), leaving 35 cases. Participant recruitment and retention flow diagram are presented in Figure 1.

2.4 | Intervention

SukapapNet was programmed using Asterisk (an open-source telecommunications programming language) and used a cloud-based computing and telecommunication platform. Call protocols and content were initially developed and studied in American English, prior to being modified to conform better with Thai clinical practice guidelines (Diabetes Association of Thailand, 2017) and cultural factors. After the automated IVR and email content were translated into Thai, three Thai

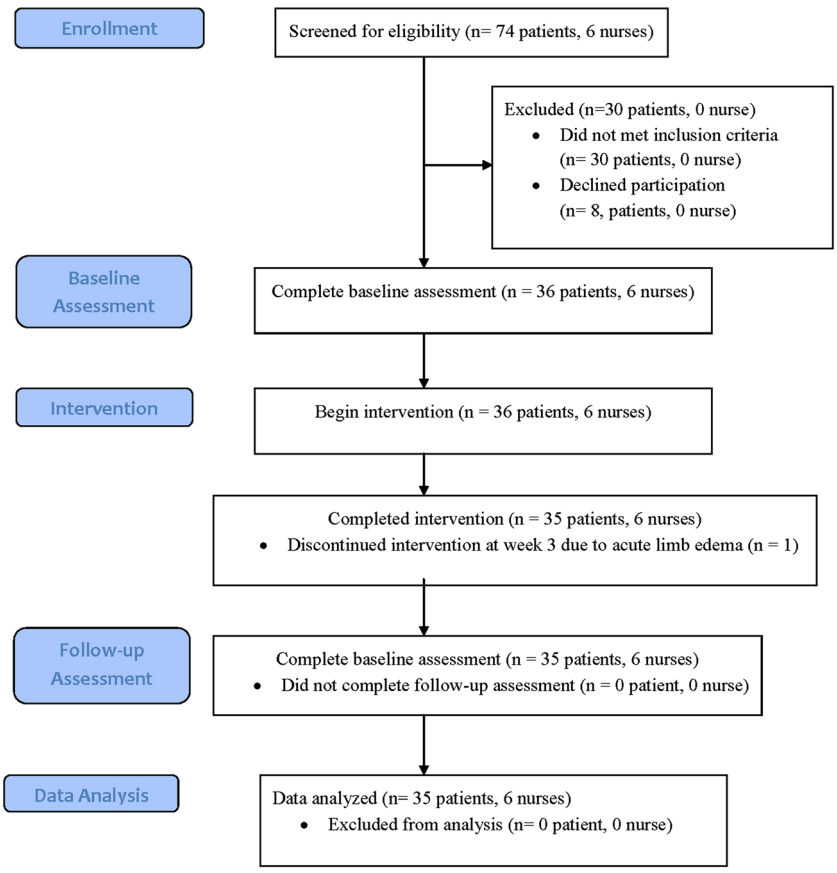

FIGURE 1 Flow diagram of participant recruitment and analysis

nurses with expertise in diabetes and assessment independently reviewed the content to verify its appropriateness for the Thai clinical and cultural contexts. Finally, the IVR content was audiorecorded by the author.

After consent and baseline assessment, patients attended a 1-hour group diabetes education session provided by a research team member. The goal of this session was to summarize basic diabetes self-management principles and train patients how to use the IVR system. In addition, patients were provided with a health log booklet for recording their diabetes self-management behaviours.

Patients then received weekly IVR calls lasting 5 to 10 minutes each for the next 12 weeks. If the patient could not respond to the first call in a given week, then the system attempted to call them back up to eight more times (as needed) within the same week. Patients used their touch-tone telephone keypads to answer the audiorecorded IVR questions, which covered symptoms of hypoglycaemia and hyperglycaemia, diabetes medication adherence, carbohydrate consumption, physical activity, sleep quality, and foot checking. Examples of IVR feedback messages are provided in Table 1.

Nurses received a 1-hour standardized session from a research team member covering diabetes management and the system. Once the patients' calls began, their nurses began receiving a weekly e-mail report summarizing each IVR assessment that each of their patients completed. Nurses were expected to follow up with patients as needed to assess their IVR-reported problems, discuss self-care strategies, and elaborate upon the educational messages provided by the system.

TABLE 1 Examples of automated interactive voice response feedback messages

Module	Example of Feedback Message
Hypoglycaemic symptoms	*When this happens, eat a small amount of sugary food like a half-cup of fruit juice or soft drink, or 1 tablespoon of table sugar or honey. After 15 minutes, you may feel better. If not, try eating some more sugary food.*
Hyperglycaemic symptoms	*High blood sugar symptoms are often caused by eating or drinking too much sugary or starchy food such as soft drinks, sweetened coffee or tea, fruit juice, candy, desserts, rice or noodles.*
Medication	*It is very important to take your diabetes medicine exactly as prescribed, every single day.*
Carbohydrate consumption	*If you eat a lot of rice and noodles, try eating half the amount you usually eat. Instead, eat foods that are lower in sugar and starch such as stir-fried meats and vegetables, soups and curries.*
Physical activity	*Choose an activity to try for 30 minutes today, tomorrow, or very soon. Consider walking to work or the market, using the stairs instead of elevators or escalators, walking with a friend and taking a walk during your work break or after dinner.*
Sleep	*Try to go to bed and wake up about the same time every day. Try your best to sleep in a dark and quiet place with a comfortable temperature. Avoid caffeine or alcohol a few hours before bedtime.*
Foot care	*Carefully check for any sores, blisters, warmth, redness or cuts. Choose comfortable shoes that do not hurt/injure your feet. Avoid walking barefoot on any hot surface. Wear shoes whenever you walk outside.*

2.5 | Data collection

Data were collected from June 2017 to November 2017. The quantitative data were collected at the beginning of intervention and at the end of the 12-week follow-up. Qualitative data were collected after intervention from semi-structure exit interviews. Also, feasibility was assessed by participant retention rate and call completion rate.

After patients gave written informed consent, they provided baseline blood samples for HbA_{1c} and FBG in their usual primary care setting. From medical records, we extracted data on patient age, gender, educational level, marital status, family income, personal/family history of chronic disease, number of hospitalizations, weight, height, waist circumference, and prescribed diabetes medications. Self-report questionnaires were pre-evaluated by two clinical nurse specialists and a nurse practitioner for appropriate content and wording.

Within 1 week after intervention was complete, patients again underwent HbA_{1c} and FBG tests and repeated most of the baseline questionnaires. We re-reviewed their medical records to identify any changes in prescribed diabetes medications since baseline. They completed an adaptation of the Client Satisfaction Questionnaire. Semi-structured exit interviews were used to evaluate patients' overall experience of the programme, perceived effects on their diabetes self-management, and usefulness of the weekly phone calls. From data automatically collected by the IVR system, call completion rate was calculated as percentage of calls that patients completed during 12 weeks that the system attempted to reach them.

After nurses provided written informed consent, their professional characteristics and attitudes regarding diabetes self-management were assessed. Within 2 weeks after intervention ended, nurses completed a nurse-adapted version of the Client Satisfaction Questionnaire (CSQ-8) and underwent a similarly adapted version of the semi-structured patient interview.

2.6 | Instruments

2.6.1 | The Diabetes Distress Scale

We assessed the diabetes-related distress using the emotional and regimen subscales from a Thai translation of the Diabetes Distress Scale (DDS) (Polonsky et al., 2005). The DDS is reliable and validated, and its indices correlate with related measures of emotional distress. Scores range from 10 to 60; higher scores indicate greater distress regarding emotional and regimen burdens (Cronbach α = .90).

2.6.2 | Self-management questionnaire

Self-management questionnaire included carbohydrate consumption, physical activity, and foot care. We measured carbohydrate consumption with the following item: "On how many of the past seven days did you eat a lot of sugary or starchy foods such as soft drinks, sweetened coffee or tea, fruit juice, candy, desserts, or extra rice or noodles?" Physical activity with the Stanford Leisure-Time Activity Categorical Item (L-Cat) (Kiernan et al., 2013), which asks respondents to classify their activity level by choosing one of six descriptive categories ranging from inactive (1) to very active and almost daily physical activity (6). Scores range from 1 to 6, and higher scores indicate greater physical activity. We measured foot care using the following item: "On how many of the past seven days and did you check your feet for sores, blisters, warmth, red areas and cuts?" Scores on both of these items can range from 0 to 7, with higher scores indicating more frequent self-care.

2.6.3 | Medical adherence

Adherence to diabetes medication was measured using eight items on the Hill-Bone Compliance Scale (Kim, Hill, Bone, & Levine, 2000), which pertained to medication use, omitting the remaining items covering low-sodium diet and appointment-keeping. Items are paired with a 4-point Likert scale ranging from 1 (never) to 4 (always), possible scores range from 8 to 32, and higher scores indicate greater medication adherence (Cronbach α = .59).

2.6.4 | Sleep quality

We measured sleep quality using the Patient-Report Outcomes Information System (PROMIS) Sleep Disturbance-Short Form (Yu et al., 2012). This four-item self-report instrument measures the quality of sleep-wake functioning (Buysse et al., 2010). Responses were scored on 5-point Likert scales, scores range from 4 to 20, and higher scores indicate greater sleep disturbance (Cronbach α = .72).

2.6.5 | Hypoglycaemic symptoms

Hypoglycaemia was assessed using a seven-item questionnaire covering the symptoms of low blood glucose symptom. The responses ranged from 0 "not at all" to 4 "6-7 days a week." The scoring range was 0 to 28; higher scores indicated more hypoglycaemic symptoms (Cronbach α = .72).

2.6.6 | Health literacy

Health literacy was assessed using a three-item screener designed for this purpose (Chew et al., 2008). Scores range from 0 to 12; and higher scores indicate worse health literacy (Cronbach α = .69).

2.6.7 | Self-efficacy

We assessed self-efficacy using the Self-Efficacy for Diabetes Scale (Ritter, Lorig, & Laurent, 2016), which has eight items paired with 10-point Likert scales ranging from 1 (not at all confident) to 10 (totally confident). Total scores range from 8 to 80, and higher scores indicate greater self-efficacy (Cronbach α = .84).

2.6.8 | Depressive symptoms

Depressive symptoms were assessed by using the Patient Health Questionnaire-8 (PHQ-8) (Kroenke et al., 2009). Its eight items have 4-point Likert scales ranging from 0 (not at all) to 3 (nearly every day). Scores range from 0 to 24, with higher scores indicating greater depressive symptom severity (Cronbach α = .77).

2.6.9 | Social support

We assessed social support using items 3 through 8 from the Norbeck Social Support Questionnaire, which is a validated measure of number, type, and quality of relationships (Norbeck, 1983). Items are scored on 5-point Likert scales ranging from 0 (not at all) to 4 (a great deal). Scores range from 0 to 32, with higher scores indicating better social support (Cronbach α = .74).

2.6.10 | Satisfaction

Patient and nurse satisfaction was assessed using the CSQ-8 (Attkisson & Zwick, 1982). Total scores can range from 8 to 32, and higher scores indicated greater programme satisfaction (Cronbach α = .88).

2.7 | Ethical considerations

This study was approved by the institutional review boards (IRBs) of the University of Michigan (HUM00118973) and Mahidol University (MUPH2016-130) and conducted under the concept of the Declaration of Helsinki.

2.8 | Data analysis

Data were analysed using Stata 14 (College Station, TX: Stata Corp LP). We used the Shapiro-Wilk test to assess normal distribution. We calculated means, standard deviations, and percentages (when applicable) for normally distributed variables, and medians and interquartile ranges (IQRs) for those with skewed distributions. Post-pre difference scores were evaluated for normality using the Shapiro-Wilk test. We used paired Student *t* tests with alpha set at 0.05 to evaluate changes in glycaemic control and self-care behaviour. We calculated Pearson correlations to assess associations between change scores for HbA_{1c}, FBG, weight, and other variables. Effect sizes were converted into Cohen *d* estimates, which we interpreted using cut-offs of 0.20, 0.50, and 0.80 as indicating small, medium, and large effects,

respectively. HbA_{1c} effects were represented in raw HbA_{1c} units to facilitate interpretation of clinical significance. Interviews were recorded and transcribed verbatim, coded, and categorized for responses. Thoughts and feelings were documented in memos, and themes were extracted from data analysis and interpretation.

3 | RESULTS

3.1 | Participants characteristics

As shown in Table 2, the patients tended to be married women with less than a secondary school education and annual household income ≤ 15,000 baht. Their ages ranged from 31 to 67 years with mean 54.9 years. They tended to have no recent hospitalizations, and mean diabetes duration was 6.1 years. All nurses were female. Their ages ranged from 35 to 46 years with mean 41.0 years, and their years of experience caring for diabetes patients ranged from 8 to 21 years with mean 12.7 years.

TABLE 2 Baseline patient and nurse characteristics (n = 35 and 6, respectively)

Characteristics	Sample
Patients	
Age in years; mean (SD)	54.9 (6.3)
Female; no. (%)	26 (74.3)
<Secondary/vocational school education; no. (%)	27 (77.1)
Buddhist religion; no. (%)	32 (91.4)
Married; no. (%)	20 (57.1)
Monthly income ≤ 15,000 Thai baht; no. (%)	28 (80.0)
Duration of type 2 diabetes in years, mean (SD)	6.1 (3.7)
Not hospitalized within the past 3 mo; no. (%)	33.0 (94.3)
Weight in kg; median (IQR)	66.0 (56.0-75.0)
BMI, kg/m^2; median (IQR)	27.0 (23.5-28.7)
Waist circumferences in cm, mean (SD)	90.7 (11.9)
HbA_{1c} in %; median (IQR)	8.2 (7.9-9.3)
Fasting blood glucose in mg/dL; median (IQR)	152.0 (131.0-190.0)
Carbohydrate consumption; median (IQR)	5.0 (3.0-7.0)
Physical activity; median (IQR)	2.0 (2.0-3.0)
Foot care; median (IQR)	7.0 (4.0-7.0)
Medication adherence; median (IQR)	30 (29.0-31.0)
Sleep disturbance; median (IQR)	10.0 (7.0-12.0)
Diabetes distress; median (IQR)	13 (11.0-19.0)
Hypoglycaemic symptoms; median (IQR)	2.0 (1.0-3.0)
Health literacy; median (IQR)	9.0 (4.0-11.0)
Diabetes self-efficacy; median (IQR)	68 (55.0-75.0)
Depressive symptom severity; median (IQR)	4.0 (2.0-7.0)
Social support; median (IQR)	21 (19.0-24.0)
Nurses	
Age in years, mean (SD)	41.0 (4.4)
Female: no. (%)	6 (100.0)
Experience in diabetes care in years, mean (SD)	12.7 (4.9)

Abbreviations: BMI, body mass index; IQR, interquartile range; SD, standard deviation.

Median baseline HbA_{1c} was 8.2% (7.9-9.3), and median FBG was 152.0 mg/dL (131.0-190.0). Median weight was 66.0 kg (56.0-75.0), and median body mass index (BMI) was 27.0 kg/m^2 (23.5-28.7). Patients tended to report high carbohydrate consumption, low physical activity, a high degree of foot care, high medication adherence, and moderate sleep quality.

3.2 | Changes in outcomes

Mean reduction in HbA_{1c} was 0.9% (P < .001) and in FBG was 14.9 mg/dL (P < .001) (Table 3). As shown in Figure 2, HbA_{1c} reduced by at least 1.0% for half of the patients and by 0.5% to 0.9% for another 23% of the patients. Diabetes medication prescriptions changed for 20 patients during the study period. However, four of these patients had their dosage reduced, whereas 11 had their dosage intensified. Among patients whose diabetes medications remained unchanged, mean HbA_{1c} reduction was 0.6%.

As shown in Table 3, there were improvements in carbohydrate consumption (P < .001), physical activity (P < .001), medical adherence (P < .001), sleep quality (P < .001), hours of sleep (P < .001), and frequency of foot care (P < .001). Significant improvements also emerged for diabetes self-efficacy (P < .001), distress (P < .05), and depressive symptom severity (P < .001). Overall, eight of the 12 self-care measures showed at least a moderate effect size in the desired direction. The absolute values of standardized effect sizes ranged from 0.3 to 0.9; among the self-care variables, carbohydrate consumption showed the greatest improvement.

Pearson correlations between post-pre differences in the outcomes were performed. Change in HbA_{1c} was significantly associated with changes in FBG and carbohydrate consumption (r = .54 and .56, both P < .001). Change in carbohydrate consumption was negatively correlated with changes in medical adherence (r = −.35, P < .05). Change in sleep disturbance was negatively correlated with change in health literacy but positively correlated with change in depressive symptom severity (r = −.34 and .35, both P < .05 respectively). A nonsignificant trend emerged for change in FBG to covary with changed carbohydrate consumption (P = .06). Effect sizes were large for changes in carbohydrate consumption and foot care (Cohen d = −.9 and.8, respectively), but not for changes in social support (Cohen d = −.1).

3.3 | Call completion

Disregarding the one patient who withdrew at week 3, the system made calling attempts to the remaining 35 patients for 12 weeks, yielding a total of 420 possible "call-weeks." Patients completed calls during 71% of weeks in which a call was attempted. The leading

TABLE 3 Post-pre changes in major variables with a correlation matrix (n = 35)

Variable	Mean (SD)	Cohen d	HbA_{1c}	FBG	CC	PA	MA	SD	FC	DD	HS	HL	DS	DSS
HbA_{1c}	−0.9 (1.6)**	−.5												
FBG	−14.9 (43.2)*	−.3	.54**											
CC	−2.1 (3.0)**	−.9	.56**	.32										
PA	0.7 (1.3)**	.6	−.01	.16	−.11									
MA	1.1 (2.0)**	.7	−.20	−.15	−.35*	−.07								
SD	−2.1 (3.2)**	−.6	−.26	−.13	−.16	−.11	.17							
FC	1.6 (2.7)**	.8	−.16	.16	−.03	.28	.05	−.09						
DD	−2.7 (7.5)*	−.4	.11	−.12	.08	−.04	−.21	.12	−.06					
HS	−0.9 (2.9)	−.3	−.05	−.05	−.33	.10	.04	.16	−.04	−.06				
HL	1.7 (3.1)	.5	.03	−.11	.09	−.03	−.22	−.34*	−.26	.11	−.27			
DS	5.4 (12.2)**	.5	−.08	.16	−.21	.12	.23	−.13	.28	−.12	−.04	.08		
DSS	−2.3 (3.4)**	−.7	−.26	−.28	−.22	−.09	−.09	.35*	−.03	.40*	.18	.05	−.21	
SS	−0.4 (3.4)	−.1	−.18	−.12	.03	.30	−.03	.08	.06	.29	−.12	.03	.19	.32

Note. Pearson correlation was used to examine the relationship among variables.

Abbreviations: CC, carbohydrate consumption; DD, diabetes distress; DS, diabetes self-efficacy; DSS, depressive symptom severity; FBG, fasting blood glucose; FC, foot care; HbA_{1c}, glycated haemoglobin; HL, health literacy; HS, hypoglycaemic symptoms; MA, medical adherence; PA, physical activity; SD, sleep disturbance; SS, social support.

**P < .001.

*P < .05.

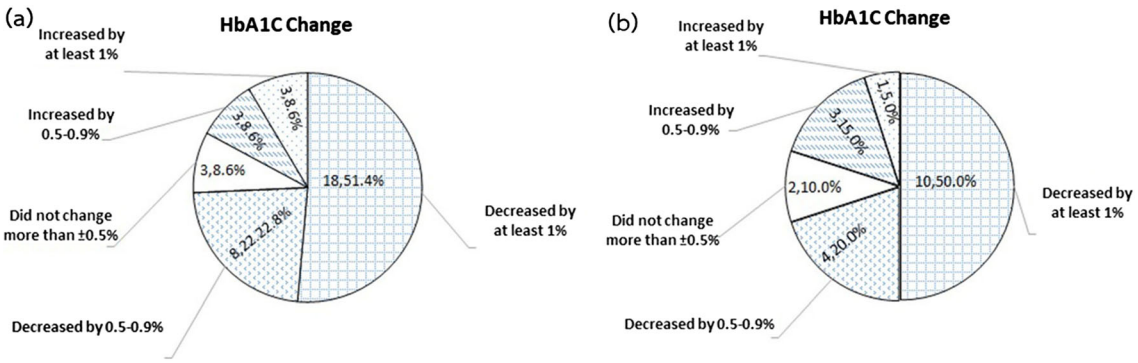

FIGURE 2 Changes in HbA_{1c} levels: (a), all patients in the study (n = 35); (b), patients whose medications remained unchanged (n = 20)

reason given for incomplete calls was "technical problems." In addition, some patients reported that they unintentionally disconnected at least one IVR call by turning off their telephone (16.9%).

3.4 | Participants' satisfaction and themes

Patients reported very high overall satisfaction with IVR (see Table 4). Most patients would definitely use the system again if it were offered and would definitely recommend the system to others. Although all nurses reported high programme satisfaction, only 33% were willing to either continue using the system or recommend it to a friend. Themes emerged as follows.

3.4.1 | Patient

Qualitative analysis of patient interviews (n = 35) revealed three main themes.

Valuable reminders

Most patients reported that the regular weekly frequency of the IVR calls helped them to perform healthy behaviours. For example, "I like it, I felt it raised my consciousness" (47-year-old female) and "Receiving calls made me pay attention more than at the lecture because I had to answer … making me remember information" (53-year-old male). Some patients indicated that the IVR messages and health log booklets were helpful. For example, "I like both (the) IVR and the booklets.

TABLE 4 Participants' intervention satisfaction

Item	Patient[a]	Nurse[b]
Overall satisfaction, mean (SD)	3.8 (0.3)	3.4 (0.4)
The intervention's service was "good" or "excellent" (%)	97	83
The intervention provided the kind of service that I generally and specifically wanted (%)	100	100
("Nearly all" or "most") of my needs were met by the intervention (%)	100	100
I would definitely recommend the intervention to friends (%)	74	33
I was ("mostly" or "very") satisfied with the amount of help the intervention provided (%)	97	100
The intervention helped me ("somewhat" or "a great deal") in more effectively coping (%)	100	100
Overall, I was ("mostly" or "very") satisfied with the intervention (%)	97	100
I would definitely repeat the intervention if it was provided to me (%)	77	33

Abbreviation: SD, standard deviation.

[a]n = 35.

[b]n = 6.

It seemed like I usually heard the messages from the IVR when I was eating," "I put my personal health record booklet on the table, and it reminded me about what I should eat every time I saw it" (54-year-old male), and "Phone calls were better than booklets" (53-year-old female).

Satisfaction with the programme

All patients reported that they enjoyed participating in the programme, even though not all of them expected significant benefits. Some patients were surprised that the programme helped them improve their self-care, because they had previously received instruction in diabetes management. For example, "I want this program, and will recommend it to my friends so they can take care of their health" (58-year-old female), "What I like most about the program is that they called me and I just listened to the content" (60-year-old female), "At first, I didn't believe this program was helpful … .If I had believed the program at the first 4 weeks, I would be better than this" (49-year-old male), "Because of the program, my consumption behavior changed the most; I eat less … . and more slowly" (54-year-old male), "This program changed my eating patterns … reduced snacks" (67-year-old female), and "I would join the program if it was continued" (58-year-old female).

System initially unpleasant

Many patients indicated that the phone connection was initially unstable. However, we were able to resolve this technical problem within the first 4 weeks of the trial. For example, "I heard the phone call, but when I pressed the number, the phone did not recognize my response when I pressed the number" (59-year-old female), "Sometimes, the system did not recognize me, even though I'd already answered the calls" (52-year-old female), and "The system should be improved" (49-year-old male).

3.4.2 | Nurses

We interviewed five (out of the six) participating nurses, and three themes were revealed.

System needs more patient engagement

Four nurses reported interest in continuing the programme, citing a variety of reasons. First, they felt that the programme enhanced patients' awareness of their diabetes. Second, they reported that the programme helped patients improve their glycaemic control. Third, they noted that the programme seemed to enhance patient-nurse relationships by triggering them to call their patients each week. For example, "For me, the program was good for patients because I could respond to patients when they had any problems without coming to see me … my patient told me she felt great and that it was like having a personal physician," "The program helped my patient with behavior modification. She used to eat a lot of carbohydrates, but now she eats less," and "Based on evaluation, 3 of my 6 patients learned to control their blood glucose levels without close monitoring … Because of the system."

System was burdensome

Although the system was seen as providing useful updates to nurses, five nurses discussed their concerns about the high number of emails that they received every week and the length of instructions that the system gave them for supporting patients' self-management. For example, "This study included only 5 to 6 patients for me, so there was no problem. However, I have approximately 400 (diabetes) patients, so this might become a burden if it reports every problem (to me)" and "The self-management support content in emails should be more concise. I printed all emails with reports for six patients every week, but I couldn't read them all. It's a lot."

System is not ideal for all (patients or nurses)

Qualitative data indicated that the programme would be improved if it gave more careful consideration to patients' age and technological literacy. For example, "The system should be used for patients with glycemic control and with the agreement of nurses," "my patients told me they sometimes asked their children to press the number," "This program can be (best) used with the new generation," and "Some patients were old" (35-year-old female).

4 | DISCUSSION

This study demonstrated the feasibility of a system of IVR monitoring with community nurse feedback for Thai patients with poorly

controlled T2DM. Willingness to enrol in the programme was high. Call completion was as comparably high that of previous studies (Aikens, Trivedi, Aron, & Piette, 2015; Gallegos-Cabriales et al., 2017) and higher than we have noted among patients in Honduras and Bolivia (Piette et al., 2013; Piette et al., 2016). After 12 weeks of the programme, patients demonstrated significant improvements in HbA_{1c}, carbohydrate consumption, physical activity, foot care, and sleep quality.

Although change in HbA_{1c} was associated with reduced carbohydrate consumption, it was not associated with changes in any other self-care behaviours. This is consistent with previous studies indicating that HbA_{1c} improvement occurs with low carbohydrate diets as opposed to normal carbohydrate diets (Kirk et al., 2008; Nielsen & Joensson, 2008). Consistent with previous studies, patients' depressive symptoms improved with self-management support (Piette et al., 2012; Piette, Weinberger, & McPhee, 2000). However, because our study had limited statistical power, these findings should be considered preliminary.

Although our system of IVR monitoring and nurse prompting could improve HbA_{1c}, qualitative data indicated some key areas for improvement. Specifically, patients were appropriately concerned with the system's initial unreliability, and nurses were concerned about the burden of receiving a high number of prompts with lengthy messages.

4.1 | Limitations

Although the strengths of this study were its high rates of recruitment and retention, implementation at multiple sites, and preliminary objective evidence of benefit, important limitations should be acknowledged. Because this study was designed to evaluate programme feasibility, it did not include a control group. Extraneous factors such as the passage of time, increased clinical attention, and repeated assessment might also explain improvement. Study power could have been insufficient to detect statistically significant differences. Finally, most participants were older adult suburban-dwelling females with low educational levels, which could reduce generalizability to other groups.

5 | CONCLUSION

A system of IVR monitoring and nurse prompting is feasible and could improve HbA_{1c}. Despite the fact that HbA_{1c} was associated with carbohydrate consumption, these findings are only preliminary. Thus, it requires verification in larger samples and a longer randomized controlled trial. Furthermore, the platform should be modified to be less burdensome to community health nurses. Improvements in nurses' support with short and concise message to their patients might result in better improved patient illness management behaviour and HbA_{1c}.

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CONFLICTS OF INTEREST

None.

AUTHORSHIP STATEMENT

PP, LS, and JA contributed to the study design and management of the project. PP and PR contributed to data collection and intervention delivery. PP, JA, LS, JS, and NM analysed the findings. PP, JA, LS, and JP contributed to the reporting on the study. All authors approved the final version for submission.

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