Development of Diabetes Telephone-Linked Care System for Self-Management Support and Acceptability Test among Type 2 Diabetic Patients

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Objective: *Develop the diabetes telephone-linked care system for self-management support and test acceptability in terms of system uses, satisfaction and perception of easiness, helpfulness, and emotion with the system.*
Material and Method: *The automated telephone system with diabetes knowledge interactive voice response (IVR) subsystem was developed to provide diversified curriculum arrangement including general knowledge module (Knowledge IVR, suggestive segment module (Suggestive IVR) and 10 QA sets for assessment with tailored information feedback (QA IVR). The system could deliver 1,120 messages over five weeks among 112 intervened participants of the on-going randomized controlled trial on its impact on glycemic control. The system analyzed the level of completed responses.*
Results: *Overall, 25.9% of the responses were intermittent, 46.4% had consistent adherences, 14.3% were poor responses, and 13.4% were non-responses. The total time use of the system, among 97/112 participants, was 6,189 minutes (mean 63.80, SD 26.63). The degree of call completeness did not vary according to the participant's socio-economic status, glycemic level, or years of diabetes diagnosis. The satisfaction of participants to the program was done by interviewed by telephone among 95 of 112 participants. Most study participants reported that they were very/moderately satisfied with the program (89.5%) regarding its usefulness and helpfulness on awareness, understanding and reminding behavior change attempts. In all, 95.8% of the responders planned to participate in the next program. Duration of time uses of the TLC was significantly correlated to the total scores of helpfulness and of emotion ($p < 0.01$; $r = 0.38$ and 0.31 respectively).*
Conclusion: *This prototype of diabetes telephone-linked care for Thai diabetes is a step forward in response to diabetes self-management education need. Further studies are needed about its efficacies on diabetes self-management improvement and glycemic control, as well as its cost-effectiveness.*

Keywords: *Diabetes, Telephone-linked care, Self-management support, Interactive voice response, Automated telephone, Diabetes self-management education*

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Diabetes self-management typically involves significant changes to daily diet habits, increase in exercise, intake of medication, and monitoring of blood sugar, blood pressure, blood lipids, and daily foot-care[1]. So it is principally managed by patients on a day-to-day basis, achievement of diabetes control depends on patient's management, and sustainability of healthy behavior change. The process of teaching people to manage the diabetes is called diabetes self-management education (DSME). Previous studies on diabetes education and its effectiveness demonstrated positive effects of DSME or a variety of outcomes, particularly at short-term follow-up, when delivered through group visits in medical and community

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settings[2-4]. Despite the proven DSME benefits of self-management, many patients may fall short of DSME because diabetes management for a single patient requires complex scheduling, medicinal regimens, and monitoring task, in addition to the counseling and patient education. Under the constraints of clinical staff shortage, context of growing patient loads and patient factors, as well as time and cost burden can be major problems for providers. To enhance the provider capability to support large number of diabetes patients, one of the interesting modalities is the use of telecommunication and information technologies.

The telephone-linked care (TLC) is being used to provide health information, advice, counseling, disease monitoring, clinical problem identification as well as enhancing patient-provider communication. The system provides either direct assessment or access to health communication intervention to patients at home. The previous studies demonstrated its positive effects on self-care behavior improvement[5-7]. The conversation between TLC and patients are entirely automated by using Interactive Voice Response (IVR) and speech technology on telephone channel. In details, TLC communicated with patients by using either pre-recorded human voice or speech synthesis and patients response to TLC by using telephone key pads.

Although the landline telephone with the spread of mobile telephone technology are almost universally available among Bangkokain, in the Thai context, no studies of automated telephone known to the authors have attempted to deliver DSME for type 2 diabetic patients or to address acceptability of this technology as an alternative education channel. To fill this gap the authors developed the diabetes telephone-linked care system for self-management support and to test acceptability.

Matrial and Method

The method was divided into two phases including development of the telephone-linked care system (TLC) and acceptability test.

Phase I: Development of TLC and diabetes interactive voice response (IVR) subsystem

Designing architecture and specification of the TLC

This TLC system utilizes an IVR system that comprises of four parts: dialog management, database management, dialog selection, and queue management. Each part of the IVR system is described below.

Dialog management: This module is used to build a conversation that users would hear when they call the TLC system. The contents of the conversation can be 1) prompt messages such as greeting a user, 2) questionnaires asking user conditions, and 3) diabetic knowledge for educational delivery. The sound that the users would hear is constructed by a Text-to-Speech (TTS) system called VAJA. VAJA is a Thai TTS system developed by National Electronics and Computer Technology Center (NECTEC). The advantage of using automatically generated sound is system flexibility as the authors could change the contents of the conversation without having to manually re-record human voice.

Database management: This module stores and manages user information and their interaction with the TLC system such as a log file for each call.

Dialog selection: This module controls the content and flow of an individual TLC conversation with each user. The programmed decision rules in the TLC system are used to select, combine, and play stored sound files of conversation segments. The determinations of selected dialog of questionnaires and knowledge management are based on logic that is applied at each step of conversation and feedback from users.

Queue management: This module controls when and how the TCL system makes a telephone call to each user.

When the TLC system makes a phone call to a user, the system asks the user a question using synthesized speech. The user then answers by pressing telephone key pads. There are two types of answers, multiple choices, and numeric quantities. Therefore, the input keypad signals play an important role in the IVR system for allowing users to provide feedback including selecting items in a menu structure presented during the progress of an automated call. The navigation is restricted to a tree-like structure[8]. To a significant advance, this TLC has been served over the internet to provide convenience to providers, administrators and educators to manage the system anywhere.

Developing diabetes self-management educational script (DSME script)

The authors considered Thai type 2 diabetes patients with low education and old age as major target users to develop the range of understandable diabetes scripts. The major objectives of the scripts were to support standard self-management education

for type 2 diabetic patients, monitor self-care management behavior of users, assess and deliver tailored diabetic self-management, reinforce health behavior and assess goal attainment. The authors extensively reviewed literatures for diabetes self-management knowledge[9-12] using them as a guidance of the first script development of diabetes knowledge bank and decision-tree of IVR subsystem. For assessment and tailored education IVR subsystem (QA IVR), the authors combined components of health behavior theories including health belief[13] and trans-theoretical model (TTM)[14] as a guidance of creating question sets and tailored suggestions. Most of QA IVR sets were combined both assessment and education including clinical symptoms, behaviors, attitudes and barriers. Then, the second draft of scripts was developed by conducting a focus group work-shop among home health visit teams, volunteer health workers, lay diabetes to revise the first draft before sending the second draft to expert consultants to review face validation. To obtain the reliability of the range of script understanding, the authors conducted field test among lay diabetes individuals, aged above 50 years, at home, and revised by home health visit teams. Then, the final scripts were transformed to text segments to create speech files in IVR subsystems.

Refining and readiness test of the system

Before extending to a large scale of acceptability test of the TLC, the authors sought the comments from three expert consultants and seven care providers to refine our TLC and adjusting the system operation. Therefore, the system was first refined based on their advice. Then, 40 diabetes volunteers were requested to complete response to the automated telephone calls of QA IVRs. The system was tested with about 50 automated calls. The authors did a final adjustment to refine the system further.

Phase II. Acceptability test

Study design

The present study was one part of the on-going randomized clinical trial of the efficacy test of the program on glycemic control and life-style changes. Therefore, the authors could control the participant selection bias. The participants in the treatment arm were interviewed through telephones after five weeks of 10 QA IVR sets delivery, which was the intensive phase of DSME intervention.

Settings of recruitment and eligible participants

The authors recruited participants at two out-patient diabetes clinics of King Chulalongkorn Memorial Hospital and of Ladkrabang Hospital. The inclusion criteria of participants were type 2 diabetes mellitus patients, above 6 months of disease duration, above 20 years of age, elevated HbA1c (above 7%), having either mobile or home telephones, no barriers to Thai communication via telephones. The authors excluded patients who had a diagnosed psychotic disorder, disabling sensory impairment, or life expectancy of less than 12 months, pregnant, active cardiovascular disease, end stage renal failure, breathing problems requiring hospitalization, or oxygen use in the previous six months. There were 112 participants for a treatment arm.

Ethic approval

This report is one part of an ongoing self-management supportive program approved by the Institute Review Boards, Faculty of Medicine, Chulalongkorn University and Ethics Committee for Researches Involving Human Subjects, the Bangkok Metropolitan Administration.

Procedure of QA IVR message delivery

Due to this TLC was automated out-bound telephone system, before participation in the intervention program, every participant was individually trained how to proceed the conversation with the system, and tried by the test IVR set until they confirmed their confidence of contacts. To ensure confidentially, the users entered their identification number, given after randomization, for the conversation proceeding. The system delivered 10 sets of QA messages to patients at their convenient times over five weeks, two different sets per week. If they missed a call, the administrator of the system would rearrange a repeated call within a week. The repeated call was not rearranged for an uncompleted response without their postpone notice.

Data collection and outcome measurement

After completion of 10-message delivery, the authors measured the adherence to the system including number of completed responses and total time utilization. The association of individual characteristics and adherence levels were analyzed. The acceptability of TLC among users was obtained through telephone interview. The questionnaires for

interviewing were modified from Piette's[15]. The first part was two single rating scale questions of global satisfaction with the system and of usefulness and one yes or no question of future participation in the next program. The second part was three sets of five point rating scale questionnaires including easiness scales (Chronbach's alpha 0.67), helpfulness scales (Chronbach's alpha 0.77), and emotion scales (Chronbach's alpha 0.77)[15].

Analysis

Demographic characteristics and acceptability data were described using proportion and mean. The difference of data between groups was tested by Chi-square test or t-test and anova based on the measurement scale. Bivariate relationships between category data were tested using Chi-square test. The authors used either Pearson or Spearman correlation, if data highly skewed, exploring the relationships between continuous data of demographic characteristics, system utilization and perception scores. $P < 0.05$ was set for significant.

Results

Development of TLC and diabetes interactive voice response (IVR) subsystem

The TLC description and capabilities

This TLC is outbound automated DSME delivery and monitoring system for educators as shown in Fig. 1. The diabetes knowledge inside IVR subsystem, summarized in Table 1, provide diversified curriculum arrangement including general knowledge modules (Knowledge IVR) freely accessed by users, suggestive segment modules (Suggestive IVR) and assessment with tailored information (QA IVR). The structures of conversation consisted of greeting and introduction speech, body of information, hanging up speech. The users' answers will guide to appropriate information feedback from IVR before next question proceeding (Fig. 2); the authors also set critical/extreme values of inappropriate answers to alert educators for follow-up calls.

The software controls assessing questionnaires and tailored diabetic knowledge management for educational delivery, message delivered programs, as well as patients' answering recorded and educator response. It transfers information about patients into the database (*e.g.*, names, telephone numbers, and best times to call) and modifies the calling protocols over time. The system controls four automated outbound telephone lines, and one forced call line for postponed call service. The other specifications of system include 1 to 3 calls per week, the schedules of contacts for 30 weeks and 1 to 30 minutes of individual TLC conversation per call.

The system can store and summarize data regarding the process of calling (*e.g.*, whether each call is completed or whether the patient hangs up before the end of the call). Patients' assessment reports can be generated from recorded data. All interactive responding data are readable, printable as PDF and summarized excel files. There is monitoring web-page to ensure the smooth operation, patient's daily response and educator feedback for critical cases.

Acceptability

The randomized participants in the intervention arm were called to response 10 QA IVR set. Demographic characteristics of 112 individuals are summarized in Table 2.

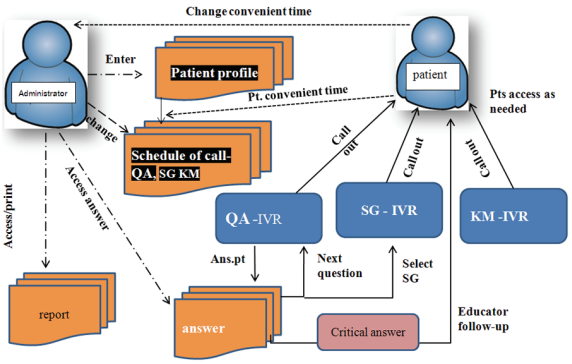

Fig. 1 Scheme of TLC outbound system; Ans. pt (answer from patients); Pts (patients); SG-IVR (suggestion interactive voice response); QA-IVR (question and answer interactive voice response); KM-IVR (knowledge management interactive voice response)

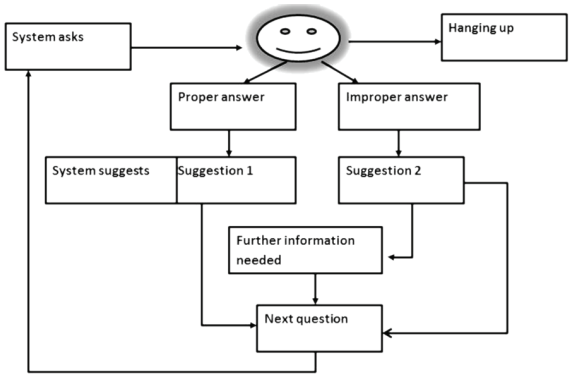

Fig. 2 Flow of Q&A interactive voice response

Table 1. Summary of interactive voice response (IVR) modules

Module: Diabetes knowledge bank; IVR name: Knowledge IVR General diabetes knowledge using as an audio book of diabetes knowledge bank offering users to access the knowledge as their needs. The designed decision tree will guide users to needed information.
Module: Suggestive segment; IVR name: Suggestive IVR The sets of specific suggestive sectors were digested from IVR knowledge bank. There are more 30 suggestive information segments providing educators to arrange tailored information.
Modules: Assessment and tailored suggestion, IVR name: QA IVR; There are 10 sets of QA IVR including: 1. Kn- test IVR: There are 13 questions of basic diabetes knowledge required 8-10 minutes to complete response. 2. Mgs IVR: There are 13 questions of health status and goal setting required 10-15 minutes to complete response. 3. Medication IVR: There are 10 questions of drug use required 5-8 minutes to complete response. 4. Diet 1 IVR: There are 13 questions of attitudes and barriers of health diet required 8-10 minutes to complete response. 5. Diet 2 IVR: There are 13 questions of frequency assessment of unhealthy diet required 8-10 minutes to complete response. 6. Ph 1 IVR: There are 6 questions of frequency assessment of moderate exercise required 4-6 minutes to complete response. 7. Ph 2 IVR: There are 10 questions of attitudes and barriers of health diet required 8-10 minute to complete response. 8. Foot-care IVR: There are 9 questions of foot-care frequency and how importance of the caring required 7-8 minutes to complete response. 9. Sms IVR: There are 10 questions of symptoms of acute complication and sugar blood level assessment required 8-9 minutes to complete response. 10. Ga IVR: There are 11 questions of goal attainment of diabetes control and health behavioral change required 8-10 minutes to complete response.

Adherence to the TLC

The data were collected from the system report. The number of participants adhered to 10 QA IVR delivery and total time utilization are summarized in Table 3. The system delivered 1,120 calls, the completion responses were 681 calls. Overall, 72% of responders completed responses to the TLC ranging from intermittent to consistent adherences (46.4% of participants consistently adhered and 4,170 minutes of time utilization). In contrast, 15 (13.4%) individuals refused response during intervention. Total time utilization among 97 participants during 10 QA IVR interventions was 6,189 minutes (mean 63.80, SD 26.63). There were no associations between glycemic level or years of disease and amount of completion responses. Bivariate analysis indicated that socio-demographic characteristics were not associated with amount of system utilization, the number of completion responses, and total time utilization.

Global satisfaction, usefulness and future participation

Ninety-five out of 112 individuals in randomized treatment arm responded to satisfaction survey through telephone at the 6th or 7th week

Table 2. Summary of participants' characteristics

Characteristics[1]	112 total participants, n	%
Gender		
Female	72	64.3
Male	40	35.7
Marital status		
Single	32	28.6
Married	80	71.4
Education		
Primary and below	71	63.7
Secondary	14	12.5
Below bachelor	14	12.5
Bachelor and above	13	11.6
Monthly income (bath)		
Less 10,000	26	23.2
10,000-50,000	85	75.9
50,001-100,000	1	0.9
Hypoglycemic medication		
Oral medication	71	63.4
Insulin	41	36.6
Age (years) (mean; SD)	54.25	9.08
HbA1c (%) (mean, SD)	9.33	1.67
Year of DM (years) (mean, SD)	7.74	5.84

[1] Data are frequency (percent); mean (SD)

Table 3. Levels of completion responses to 10 QA IVR delivery; and time utilization

Levels of completed response to system calls	112 participants		97 responders
	Participants: n (%)	Total completion responses: calls; (mean, SD)	Total time use[5]: minutes; (mean, SD)
Non-response[1]	15 (13.4)	0 (0)	-
Poor response[2]	16 (14.3)	44 (2.75, 1.06)	393 (24.56, 9.75)
Intermittent response[3]	29 (25.9)	177 (6.1, 0.86)	1,626 (56.07, 15.26)
Adherence[4]	52 (46.4)	460 (8.8, 0776)	4,170 (80.19, 19.70)
Mean	-	681 (6.08, 3.29)	6,189 (63.80, 26.63)

[1] No completion response; [2] 10%-40% completion responses of 10 calls; [3] 50%-70% completion responses of 10 calls; [4] 80%-100% completion responses of 10 calls; [5] $p < 0.05$

Table 4. Summary of global satisfaction, usefulness and future participation

Single questionnaire	95 responders; n (%)				
	Very satisfied (5)	Moderate satisfied (4)	Neither (3)	Moderate dissatisfied (2)	Very dissatisfied (1)
Global satisfaction	38 (40.0)	47 (49.4)	7 (7.4)	1 (1.1)	2 (2.1)
Usefulness	47 (49.4)	39 (41.1)	7 (7.4)	1 (1.1)	1 (1.1)
Future participation					
Yes	91 (95.8)				
No	4 (4.2)				

interval of intervention. Overall (Table 4), 89.4% of 95 responders reported satisfaction with the TLC (40% were very satisfied and 49.4% were moderate satisfied) while 90.4% reported usefulness of the TLC (49.4% reported very usefulness, 41.1% reported moderate usefulness). For the future, 95.8% of responders committed to participate in future automated programs. There was only significant difference in the rating scale mean of global usefulness among different occupation groups ($p = 0.02$).

Perception of easiness, helpfulness, and emotion with the TLC

Table 5-7 show the report of perception of easiness, helpfulness and emotion with TLC. Overall, when asked about the perception of easiness with language understanding, voice clarity, dialog speed, and easiness of pressing telephone button, the respondents reported mostly and always positively about the easiness with the TLC calls. The report of helpfulness perception of getting more attention from physicians, getting new knowledge and reminding behavior change attempt were similar to easiness perception. Overall, emotion of happiness, fun and acceptance to the length of conversation were mostly and always positive. Bivariate analysis indicated significant correlation ($p < 0.01$) between time use and total helpfulness scores ($r = 0.38$) and total emotion scores ($r = 0.31$).

Discussion

In the current diabetes TLC, there are three modules of the diabetes educational module that provide long-distant diversified DSME curriculum including general diabetes knowledge IVR module for general diabetes self-care management, suggestive IVR module and 10 sets of QA IVR module. The suggestive IVRs and 10 QA IVR sets provide educators to arrange specific education modules for targeted groups such as unhealthy dietary behavior, exercise behavior, foot-care problem, etc. In particular, QA IVR sets could be used as both educational and assessment tools. The software controlled computer offers flexibilities of the stored knowledge bank improvement, call schedules,

Table 5. Report of easiness with TLC

How many calls are you satisfied with these items?	95 responders; n (%)				
	Always (5)	Mostly (4)	Sometimes (3)	Rarely (2)	Never (1)
Language understanding	76 (80.0)	15 (15.8)	3 (3.1)	0 (0)	1 (1.1)
Voice clarity	75 (78.9)	13 (13.7)	5 (5.2)	1 (1.1)	1 (1.1)
Dialog speed	78 (82.1)	12 (12.6)	4 (4.2)	1 (1.1)	0 (0)
Pressing key pad of telephone	67 (70.5)	14 (11.6)	12 (12.6)	3 (3.2)	2 (2.1)

Table 6. Report of helpfulness with TLC

How many calls do you feel helpfulness of these items?	95 responders; n (%)				
	Always (5)	Mostly (4)	Sometimes (3)	Rarely (2)	Never (1)
Get more attention from doctors	34 (35.8)	46 (48.4)	10 (10.5)	2 (2.1)	3 (3.2)
Get more new knowledge	40 (42.1)	40 (42.1)	11 (11.6)	1 (1.1)	3 (3.1)
Reminding self- management	45 (47.4)	40 (42.1)	6 (6.3)	2 (2.1)	2 (2.1)

Table 7. Report of emotion to TLC

How many calls do you feel positive emotion?	95 responders; n (%)				
	Always (5)	Mostly (4)	Sometimes (3)	Rarely (2)	Never (1)
Happiness	27 (28.4)	42 (44.2)	24 (25.3)	0 (.0)	2 (2.1)
Fun	22 (23.1)	36 (37.9)	31 (32.6)	3 (3.2)	3 (3.2)
Acceptance to length of conversation	30 (31.6)	52 (54.7)	8 (8.4)	3 (3.2)	2 (2.1)

duration of intervention and alerting system problem and participant responses. The findings of acceptability were similar to other studies[15,16].

There are some limitations to the present study including a system bug in the early stage of program running due to the telephone line system and negative attitude of participants to telephone call abuse. In addition, this type of technology is new to the participants and requires times in explaining, recruiting, and getting used to the system. Moreover, some changed their telephone number and unable to notice, but it is a weakness of out-bound TLC. A few would like to call in to get further diabetes information assessment at their convenient time.

Conclusion

This prototype development of diabetes TLC for Thai is a step forward in response to DSME need. The results confirmed the authors' confidence of this TLC as an intervention tool for diabetes self-care support. Further studies need more investigation of the TLC efficacies including effective long-distance education tools, efficacy of diabetes self-care improvement, glycemic control, as well as its cost-effectiveness. The system should extend call-in service in the near future.

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Potential conflicts of interest

None.

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การพัฒนาระบบการบริบาลทางโทรศัพท์เพื่อส่งเสริมการดูแลโรคเบาหวานด้วยตนเองและทดสอบการยอมรับของในผู้ป่วยเบาหวานชนิดที่ 2

นิตยาวรรณ กุลณาวรรณ, วิโรจน์ เจียมจรัสรังษี, สมพงษ์ สุวรรณวลัยกร, ฐณัฏฐา กิตติโสภี, กุลวรา เมฆสวรรค์, ณัฐนันท์ ทัดพิทักษ์กุล, ขัตติยะ มั่งคั่ง

วัตถุประสงค์ของงานวิจัยคือพัฒนาระบบการบริบาลผ่านโทรศัพท์อัตโนมัติเพื่อส่งเสริมการดูแล โรคเบาหวานด้วยตนเอง และทดสอบการยอมรับต่อระบบในประเด็นเกี่ยวกับการใช้ระบบความพึงพอใจ และประโยชน์ของระบบโดยรวมการรับรู้ความง่ายของการใช้งานความช่วยเหลือในการดูแลตนเอง และการตอบรับทางอารมณ์ต่อระบบ

ผู้รายงานได้พัฒนาระบบโทรศัพท์อัตโนมัติพร้อมระบบเสียงโต้ตอบเกี่ยวกับความรู้เรื่องเบาหวาน 3 หมวด ประกอบด้วยหมวดความรู้ทั่วไปเกี่ยวกับโรคเบาหวาน หมวดคำแนะนำเฉพาะเรื่อง หมวดชุดคำถามตอบจำนวน 10 ชุด ซึ่งเอื้อต่อการจัดหลักสูตรการให้ความรู้ตามความต้องการของผู้ป่วยเบาหวานชนิดที่ 2 และการศึกษานี้เป็นส่วนหนึ่งการศึกษาผลลัพท์ของระบบต่อการควบคุมน้ำตาลในเลือดโดยการสุ่มตัวอย่างเพื่อแยกกลุ่มได้รับการแทรกแซงและกลุ่มควบคุมกลุ่มละ 112 ราย ระบบโทรศัพท์ติดต่อไปยังผู้ป่วยทั้งสิ้น 1,120 ครั้ง ในระยะเวลา 5 สัปดาห์ ผลการวิเคราะห์ระดับของความถี่การรับโทรศัพท์ พบว่ากลุ่มไม่ตอบรับโทรศัพท์เลย คิดเป็นร้อยละ 13.4 กลุ่มที่รับโทรศัพท์จำนวนน้อยครั้ง คิดเป็นร้อยละ 14.3 ผู้ป่วยตอบรับไม่ต่อเนื่องคิดเป็นร้อยละ 25.9 และผู้ป่วยตอบรับต่อเนื่องอย่างสม่ำเสมอคิดเป็นร้อยละ 46.4 และผู้ป่วย 97 ราย ที่ตอบรับโทรศัพท์มีจำนวนเวลาที่ใช้บริการจากระบบรวมทั้งสิ้น 6,189 นาที (ค่าเฉลี่ยเท่ากับ 63.80 ค่าเบี่ยงเบนมาตรฐานเท่ากับ 26.63) อีกทั้งไม่พบความสัมพันธ์ระหว่างลักษณะทั่วไปของผู้ป่วยกับปริมาณการใช้ตอบรับโทรศัพท์ และผลจากการสัมภาษณ์ผู้ป่วยจำนวน 95 ราย ในกลุ่มที่ได้รับการบริการแทรกแซงพบว่าผู้ป่วยส่วนมากมีความพึงพอใจต่อระบบ และให้ความเห็นว่าระบบโทรศัพท์นี้มีประโยชน์ ช่วยเตือนให้ปรับพฤติกรรมในการดูแลโรค เพิ่มความเข้าใจในความจำเป็นของการปรับเปลี่ยนพฤติกรรม ผู้ป่วยร้อยละ 95.8 ยินดีเข้าร่วมโครงการเช่นนี้ในอนาคต และพบว่าจำนวนเวลาสนทนาทางโทรศัพท์มีความสัมพันธ์อย่างมีนัยสำคัญกับการรับรู้ความช่วยเหลือ และทัศนคติทางอารมณ์ ($p < 0.01$; $r = 0.38$ และ 0.31 ตามลำดับ)

ผลงานต้นแบบของระบบการดูแลผู้ป่วยเบาหวานครั้งนี้เป็นเพียงก้าวแรกของการนำระบบโทรศัพท์มาประยุกต์เข้ากับการให้ความรู้เพื่อสนับสนุนการดูแลตนเองของผู้ป่วย งานวิจัยอันดับต่อไปควรเป็นการศึกษาผลลัพท์ระยะยาวเกี่ยวกับพฤติกรรมการดูแลตนเอง และการควบคุมน้ำตาลในเลือดศึกษาต้นทุนและความคุ้มค่าของระบบ