ORIGINAL ARTICLE

Effects of a self-management support program delivered through telehealth services on self-management behaviors to delay renal impairment in public health volunteers with type 2 diabetes

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Received: 23 November 2024 **Revised:** 25 January 2025 **Accepted:** 8 February 2025 **Available online:** September 2025
DOI: 10.55131/jphd/2025/230313

ABSTRACT

Diabetes is a major global public health problem, and patients have a high risk of complications and mortality. Changing patient behavior through telehealth monitoring can help reduce the risk of chronic kidney complications. This experimental study aimed to evaluate the effectiveness of a self-management support program delivered through telehealth services in improving self-management behaviors to delay kidney deterioration in healthy volunteers with type 2 diabetes. The sample was selected through multistage random sampling and consisted of 102 participants, who were divided into experimental and control groups with 51 participants each. The experimental group participated in a self-management support program based on Lorig and Holman's self-management concept, focusing on six key self-management skills. The program included health education delivered through videos, self-management behavior tracking, and communication through the LINE application. A questionnaire was used to assess self-management behaviors related to delaying kidney deterioration, particularly in terms of food consumption and exercise. The study duration was 12 weeks. Data were analyzed using descriptive statistics, independent t-tests, and paired t-tests. After the experiment, the experimental group had significantly higher mean scores for eating and exercise behaviors ($M = 71.47$, $SD = 9.31$) than those recorded before the program ($M = 47.39$, $SD = 9.06$) ($p < .001$). These findings suggest that a self-management support program delivered through telehealth can effectively promote behavior modification, particularly in maintaining normal blood sugar levels, which may help prevent kidney failure in individuals with type 2 diabetes. The study recommends further research to compare blood sugar levels (hemoglobin A1C) and their effect on glomerular filtration rates before and after the intervention. It also highlights the importance of closely monitoring the behaviors of health volunteers with type 2 diabetes from its onset.

Keywords:
renal impairment; self-management behavior; telehealth; type 2 diabetes

Citation:
Rakchanok Rattanadachakul, Juntima Rerkluenrit, Rukchanok Koshakri. Effects of a self-management support program delivered through telehealth services on self-management behaviors to delay renal impairment in public health volunteers with type 2 diabetes. J Public Hlth Dev. 2025;23(3):165-178 (https://doi.org/10.55131/jphd/2025/230313)

INTRODUCTION

Diabetes is a long-standing global noncommunicable disease that significantly contributes to complications and mortality worldwide. According to the International Diabetes Federation in 2021, 536 million people were living with diabetes globally, and this number is projected to increase to 783 million by 2045.[1] Similarly, the World Health Organization (2021) reported that the number of people with diabetes is projected to double by 2030, resulting in approximately 3.2 million deaths annually attributed to complications from diabetes—equating to an average of six deaths every minute.[2] In Thailand, the Health Information Center of the Ministry of Public Health reported in 2023 approximately 300,000 new cases of diabetes, with 70% of patients unable to maintain their blood sugar levels within an appropriate range.[3] A study involving 30,377 patients with type 2 diabetes across Thailand revealed that 40% of these individuals also had chronic kidney disease (CKD).[4] Chronically high blood sugar levels increase pressure on the kidneys, damaging the capillaries in the glomerulus and reducing kidney efficiency, ultimately resulting in diabetic nephropathy, which is also referred to as diabetic kidney disease (DKD).[5] Research shows that effective diabetes management can significantly reduce kidney complications. For instance, good blood sugar control has been found to reduce kidney complications by 7%.[6] In addition, lowering the average hemoglobin A1C (HbA1C) level by 1% can decrease complications in small blood vessels by 37%.[7] These findings emphasize the critical link between high blood sugar levels, diabetes-related complications, and kidney health.

The above background indicated that hyperglycemia contributes to diabetes-related pathology and complications, including DKD. Therefore, lifestyle modification is essential, and patients with diabetes are recommended to participate and recognize the importance of self-management, which must be performed regularly and continuously as a part of daily life[8-9] because self-management is an essential skill for those with diabetes. Diet and exercise self-management result in significantly lower blood sugar levels.[10-11] Moreover, self-management for strictly controlling blood sugar levels is vital because it significantly delays the development of renal complications.[12-13]

Technological progress has improved society and daily life has also led to changes in lifestyles and behaviors, resulting in increased sedentary behavior[14] and the consumption of overly flavored foods and popular, readily accessible foods. Consequently, the body loses balance and cannot control blood sugar levels.[15-16] The health service system has also entered the digital era, which has contributed to the enormous role of information technology in the health system. Therefore, the use of technology to promote and support self-management through monitoring by the telehealth service system serves as a means of modernizing activity models. This approach will encourage patients to gain understanding and easy access, enabling them to effectively change their self-management behaviors related to diet and exercise.

According to statistics from the Department of Health, Bangkok Metropolitan Administration, 11,598 individuals are public health volunteers (PHVs).[17] Of this number, 25% were diagnosed with type 2 diabetes, and 70% had HbA1C levels >7%. Most PHVs consumed excessive diets, engaged in inconsistent exercise, and did not recognize the risks of complications from diabetes. A previous study found that patients with diabetes often neglect appropriate health behaviors.[18] To prevent this, positive health behavior changes must be sustained throughout life. Without ongoing monitoring and support, these beneficial

effects are unlikely to be maintained in the long term.[19-20]

The literature review indicates that an effective self-management program has had positive effects on patients with diabetes. These patients must participate in self-management activities and monitor their health behaviors daily. This approach can be structured as a self-management program designed to change behaviors through knowledge acquisition and skills training to support appropriate self-care. In addition, previous studies have found that modern technology encouraged patients to use technology in health behavior adjustment for self-management, consistent with new lifestyles in the Innovation 6.0 era.[21-22] The activities in the self-care program for patients involve the use of technology and presentation of health information, news, and knowledge through applications such as LINE, which is a widely used communication application in Thailand.[23-24] The results of the study indicate that integrating self-management support programs with technology for follow-up through telehealth systems in the care of people with type 2 diabetes can influence health behaviors. This approach fosters a sense of self-care, enabling patients with type 2 diabetes to achieve better control over their blood sugar levels.[25-26-27] In addition, teaching and monitoring using modern technology may result in significantly reduced blood sugar levels.[28-29-30] In addition, telenursing improves perceived self-efficacy and lifestyle patterns. This makes patients with type 2 diabetes better able to control their blood sugar levels.[31] The analysis of data management on the website revealed that behavioral changes help patients improve their well-being and prevent diabetes-related complications.[32] Studies have shown that the use of technology in telehealth monitoring can influence health behaviors. Patients can make decisions related to daily self-care, particularly concerning dietary choices, dietary control, and proper exercise.[33-34]

Therefore, the researchers were interested in developing and evaluating the outcomes of a self-management support program delivered through telehealth to prevent renal impairment in patients with type 2 diabetes. The program, which was based on the literature and self-management concept of Lorig and Holman (2003),[35] involves activities through the LINE mobile application. The program, designed in an easy-to-understand format, offers information on diabetes and self-management to prevent complications, along with follow-up skills training. The program encourages patients to actively participate in managing their diseases by fostering awareness through three key activities: 1) medical treatment management, 2) role management and self-management planning, and 3) emotional management, which builds self-management confidence. Patients are trained in six essential skills, namely, problem-solving, decision-making, resource utilization, partnering with healthcare providers, taking-action, and self-tailoring. These skills were included in the strategies for the application of knowledge and self-management practices that are tailored to meet individual needs. Moreover, the program includes a self-care manual for patients with diabetes aimed at delaying kidney failure by providing knowledge about diabetes, its complications, and related kidney disease. It features eight video lessons, dietary tracking, and exercise behaviors (such as arm-swinging and walking), and two quizzes to reinforce understanding and monitor engagement in exercise. The program also offers advice, suggestions, and a platform for patients to share experiences through LINE to help them make appropriate adjustments in diet and exercise behaviors.

The researchers believe that the program will help patients with diabetes

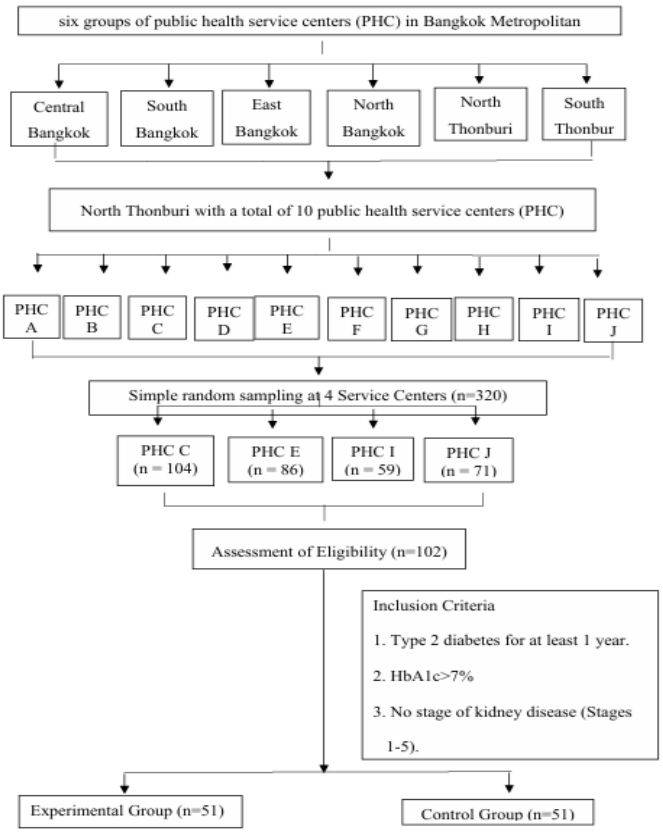
modify their daily self-care behaviors and provide a framework for community nurses and healthcare professionals to apply the knowledge and skills gained from the study. Ultimately, the researchers hope that the program will reduce the risk of kidney complications and slow the onset and progression of CKD.

METHODS

Study design

This study used a randomized controlled trial design. The study population consisted of PHVs diagnosed with type 2 diabetes and living in Bangkok. The experimental and control groups were formed using a multistage sampling method. The sample size was calculated using the G*Power 3.1.97 program with power analysis by setting the significance level at 0.05 and the power of the test at 0.80. The researchers set the medium effect size at 0.50.[36] The sample size was 51 people per group, totalling 102 study participants.

The inclusion criteria were as follows: PHVs diagnosed with type 2 diabetes for at least 1 year with HbA1c >7%, prescription of oral tablets only, good consciousness and ability to engage in the program, possession of a smartphone that can be installed with LINE, ability to communicate in Thai language, and training and registration as a Bangkok PHV, with work experience of at least 1 year. Meanwhile, the exclusion criteria were as follows: inability to participate in activities until the end of the program and diagnosis of any stage of kidney disease. Regarding participant selection, the researcher used the random-number function of Microsoft Excel to generate randomization sequences. The samples were then randomly assigned to the study groups through random numbers without replacement (Figure 1).



As for the intervention, an experimental design was used in a 12-week self-management support program delivered through telehealth services from January 2024 to April 2024. In the experimental group, the details of the program were as follows:

Week 1: The researchers established rapport to clarify the objectives; collect pretest data involving general information and self-management behavior before program participation; provide on-site instruction about type 2 diabetes, online instruction on the use of LINE for practicing skills 1-5, and a self-care manual for patients with diabetes to delay diabetes-related renal impairment. The participants received a self-management behavior notebook on delaying diabetes-related kidney failure.

Weeks 2–6: The researcher sent videos involving diet and exercise; for example, how to calculate daily calorie intake, food exchange, carbohydrate counts, sample menus, walking with arm-swinging exercises, and self-management through the LINE application.

Weeks 7–11: The patients reviewed their knowledge and improved their self-management goals, as well as dietary and exercise behaviors for type 2 diabetes control, to prevent diabetes-related renal disease complications. The researcher tracked the progress of dietary and exercise habits at home through LINE or by phone for 15 min per session to assess issues and obstacles encountered.

Week 12: The researchers allowed the participants to exchange experiences, reflect on self-management, and discuss successes, common problems, and obstacles. At the end of the program, the researchers collected data on self-management behavior.

For the control group, in week 1, the researchers established rapport with the participants to clarify the objectives and collect pretest data involving general information and self-management behavior. Then, all participants received routine care from weeks 2–11. Finally, at week 12, the researcher collected the same data as in week 1.

Measurement

The researchers developed the dietary behavior and exercise behavior questionnaires by adapting existing tools relevant to the research objectives. The language and content were adjusted to match the educational level and comprehension abilities of the experimental group, ensuring that the questionnaires were appropriate and accessible for the target population. The instruments used in this research consisted of a 16-item personal information questionnaire and a self-management behavior questionnaire containing a set of questions on the frequency of self-management behaviors involving dietary intake and behavior. The questions were close-ended and ranked from 1 to 4 points on a 4-point rating scale. The total scores ranged from 25 to 100 points, with high scores indicating higher self-management behavior.

Besides the questionnaires, this study used the 12-week self-management support program through researcher-developed telehealth services based on Lorig and Holman's (2003) concept of self-management together with a review of related research. The activities included on-site instruction in which the researchers used descriptive media and lectures accompanied by slides. In the online instruction, the researchers sent instructional videos through the LINE group and tested comprehension with two exercises administered through Google Forms to assess skills in searching for information on set topics. Participants were required to practice six skills necessary for self-care management, including problem-

solving, decision-making, resource utilization, partnering with healthcare providers, taking action, and self-tailoring skills. A self-care guide for patients with diabetes focused on delaying renal impairment, which contained information on diabetes-related kidney disease, dietary intake, and exercise for the prevention of diabetes-related kidney disease, was used. Moreover, teaching materials consisting of lesson plans and slides, eight instructional videos, and two sets of exercises were developed.

To validate the research instrument quality, the researcher had the experimental instruments tested for content validity and item objective congruence indices of the items by seven qualified experts, and the instruments received an IOC score of 0.89. Thirty sets of questionnaires on readiness to exercise were checked for accuracy and tested for reliability among PHVs with type 2 diabetes in one community, which has similar qualities to the study population. Cronbach's alpha coefficient was 0.89. The content validity index was 0.95.

Statistical analysis

Data were analyzed using a statistical analysis software package, including descriptive demographic data (frequency, percentage, mean ± SD). Nominal and ordinal data were compared using the chi-square or Fisher's exact test, and interval data were analyzed using the independent t-test. Normality was assessed using the Kolmogorov–Smirnov test. The mean self-management behavior scores on diet and exercise were compared between the groups using an independent t-test and then compared before and after the intervention using paired t-test statistics.

RESULTS

In this randomized controlled trial with a two-group pretest–posttest design, the sample consisted of a total of 102 PHVs with type 2 diabetes, who were divided into groups of 51 people each. No significant variances were found between the two groups (p-value > 0.05). Most participants were aged ≥60 years with education levels less than or equal to junior high school and were not engaged in any occupations other than being PHVs. None of them smoked or drank alcohol. The medical records on the history of illness showed that most of the participants had body mass indices above the normal limit. The diabetes duration was between 1–5 years, and most had diabetes with other chronic conditions (Table 1).

Table 1. Comparison of the baseline characteristics of the experimental and control groups, mean and SD (N = 102)

General information	Experimental (n = 51)		Control (n = 51)		p-value
1. Gender					
Female	44	(86.3%)	40	(78.4%)	.299[a]
Male	7	(13.7%)	11	(21.6%)	
2. Age (years)					
40–50	1	(2.0%)	1	(2.0%)	.698[b]
51–59	15	(29.4%)	13	(25.5%)	
>60	35	(68.6%)	37	(72.6%)	
3. Education level					
≤Junior/senior	31	(60.8%)	36	(70.6%)	.536[a]
High school	12	(23.5%)	10	(19.6%)	
Associated degree and higher	8	(15.7%)	5	(9.8%)	

General information	Experimental (n = 51)		Control (n = 51)		p-value
4. Occupation (other than PHV)					
Agriculture	3	(5.9%)	1	(2.0%)	.753[a]
Work for hire	10	(19.6%)	9	(17.6%)	
Trade	9	(17.6%)	9	(17.6%)	
Unemployed	29	(56.9%)	32	(62.8%)	
5. Body mass index (m^2/kg)					
18.5–22.9	14	(27.5%)	20	(39.3%)	.609[b]
23.0–24.9	13	(25.5%)	9	(17.6%)	
25.0–29.9	14	(27.5%)	10	(19.6%)	
≥30	10	(19.6%)	12	(23.5%)	
6. Diabetes duration (years)					
1–5	23	(45.1%)	31	(60.8%)	.079[b]
6–15	18	(35.3%)	15	(29.4%)	
>15	10	(19.6%)	5	(9.8%)	

[a] chi-square test, [b] independent t-test.

The mean overall self-management behavior scores and the mean scores for self-management activities, including dietary and exercise behaviors, among PHVs with type 2 diabetes were compared. Specifically, the experimental group had a mean score of 71.47 (SD = 9.31) points, whereas the control group had a mean score of 47.39 (SD = 9.06) points, and the variances were significant (p-value < .001). Furthermore, the experimental group had mean dietary and exercise scores that were 24.08 points higher than the scores of the control group (Table 2).

Table 2. Mean and SD of the self-management behavior of public health volunteers with type 2 diabetes in the experimental and control groups at posttest (n = 102).

Self-management behavior	Experimental (n = 51)		Control (n = 51)		t	df	p-value
	M	SD	M	SD			
Diet intake	45.80	7.10	31.14	8.10	9.72	100	<.001
Exercise	25.67	5.07	16.25	6.09	8.49	100	<.001
Self-management behavior	71.47	9.31	47.39	9.06	13.53	100	<.001

Comparison of the mean overall and individual self-management behavior scores, including dietary and exercise behavior scores, within the groups at pre- and post-test showed significant differences (p-value < .001). The mean posttest score for dietary and exercise behavior in the experimental group was 71.47 (SD = 9.31) points, and the mean pretest score for dietary and exercise behavior was 47.39 (SD = 9.06) points. The experimental group had a higher mean score for dietary and exercise behavior than that obtained at the pretest by 24.08 points.

DISCUSSION

Regarding the first research hypothesis, after receiving the self-management support program through telehealth services, the experimental group had a better mean score on self-management behaviors to delay kidney failure than the control group after 12 weeks. After the experiment, the

experimental group had a higher mean score for self-management behaviors to delay kidney deterioration in terms of diet and exercise (M = 71.47, SD = 9.31) than the control group (M = 47.39, SD = 9.06). The mean scores for self-management behaviors related to diet and exercise to delay kidney deterioration differed significantly between the two groups (p-value < .001).

The findings are attributed to the enhanced knowledge and skills of PHVs gained from the program, which involved activities through the LINE application. The activities provided information and education on diabetes, DKD, dietary intake, and exercises (such as walking and swinging arms) in video format and the use of technology to monitor skills training. As a result, PHVs have taken ownership of health by engaging in appropriate behaviors while practicing to enhance the six skills.

For problem-solving skills, PHVs solved problems and obstacles and understood the benefits of implementing the plan. They were also able to change their behavior, by accepting and choosing a solution that suited them. This finding is consistent with the results of Atiyan Sonkasetrin et al.[37] who indicated that PHVs could modify their behavior only when supported by various positive factors, such as knowledge about the benefits and drawbacks of the program.

Regarding decision-making skills, fostering a community for sharing opinions in problem-solving allowed PHVs to determine the best course of action for themselves. This finding aligns with the results of a study on healthcare behaviors aimed at delaying renal impairment in patients with diabetes and hypertension. The study indicated that changing health behaviors through awareness of the benefits gained from group activities, discussions, and collective planning allowed participants to weigh the benefits against challenges and jointly decide on various activities necessary for behavioral change.[38]

Moreover, resource utilization skills enabled patients to access information effectively. Researchers used engaging learning media using mobile phones, featuring images and sounds with short, concise, easily accessible content that is quick to review as often as needed. This approach aligns with the findings of a study on a self-care support project through LINE, which revealed that patients with CKD who used the application demonstrated better self-care behaviors than those receiving standard treatment. The program's use of easy-to-understand media promoted convenience, speed, and accuracy of information. It also emphasized repetitive activities, allowing patients with CKD to develop self-care skills tailored to their needs.[39-41]

As for partnering with healthcare providers, the researchers called to follow up on exercises by swinging arms and walking. The PHVs participated in self-care planning, expressed opinions, and exchanged information in the LINE group, promoting cooperation within the experimental group and between the experimental group and researchers. This finding is consistent with the results of an earlier study involving patients who adhered to a self-management support program for health behaviors. The program offered educational resources, facilitated the development of problem-solving skills, and encouraged symptom reporting while planning and making decisions together with health professionals. This approach cultivated good relationships and mutual trust.[42]

For the fifth skill, taking-action enabled PHVs to practice repeatedly in areas where they previously lacked confidence. Engaging in these activities themselves helped them learn how to modify behavior or mitigate risky behaviors. This is consistent with the provision of online resources for

controlling carbohydrate intake and encouraging exercise through LINE, along with providing a self-management manual for patients with diabetes to review at home. After participating in the self-management program, the experimental group gained higher self-management behavior scores compared to the baseline scores (p-value = 0.001) and to the scores of the control group (p-value < 0.001).[26]

Regarding self-tailoring skills, this skill involved sending online behavioral notebooks to PHVs through LINE, enabling researchers to observe changes in behavior weekly, which prompted PHVs to continue their practice until they felt more confident and changed their views on their behaviors. The participants modified their health behaviors, engaged in exercises to expend more energy, and adopted dietary practices designed to control their blood sugar levels. This led to lower blood sugar levels and increased kidney function, which may slow the progression of diabetes-related kidney deterioration.[43]

The results indicated that the experimental group exhibited better self-management behaviors focused on slowing down the progression of renal impairment through dietary choices compared with the control group. The experimental group modified their activity patterns to fit their needs. They managed their condition by adjusting eating patterns, choosing nutritious foods, walking, and exercising by swinging their arms. They chose simple exercises that required only determination and time. This result was in congruence with the results of Piyaporn Sitsakulanan and Phonsawan Khamthip, who reported that after participating in a self-management program, their patients had higher dietary intake and arm swing behavior scores than before joining the program. [44]

As for the second hypothesis, after participating in the self-management support program delivered through telehealth services, the experimental group's average score for self-management behavior aimed at delaying the progression of renal impairment was higher than that before the experiment. This finding indicated that the program enabled the PHVs to gain knowledge and develop skills effectively for self-care application. The use of the LINE application for coordination, appointments, and news notifications aligns with the concept of telenursing, which supports nursing service systems for the public in all forms. This approach ensures that the public can access health services equitably and comprehensively.[45] Furthermore, the use of LINE increases participants' confidence in self-management and encourages them to adopt and model appropriate health behaviors.[46] Self-management through telehealth services, which organize specific activities each week, provides clear and appropriate information on each topic, and allows patients with diabetes to remember more.[47] These results were consistent with the findings of a study on self-management support by a multidisciplinary team focused on behavior modification in terms of food consumption, rational medication use, and exercise. The study found that self-management support improved self-management behavior and clinical outcomes of patients with CKD. The sample group had a significant increase in the mean scores for self-management behavior and glomerular filtration rate at the p-value < 0.05 level.[48]

LIMITATION

The samples of this study were PHVs living in Bangkok. Moreover, all of them can use the LINE application.

RECOMMENDATIONS

PHVs act as role models in health management and are closely connected to their communities in providing ongoing consultations to residents. PHVs' use of the telehealth self-care support program as a guideline to promote and manage self-care has enhanced the community's awareness of health promotion and sustainable self-management of health issues. Integrating this program with the community diabetes care guidelines provided by healthcare professionals confirms the role of PHVs in monitoring and encouraging behavioral change, raising self-care awareness to reduce the risk of diabetic nephropathy complications, and supporting the development of health service policies.

AUTHOR CONTRIBUTIONS

RR: Project administration, conceptualization, methodology, data collection, analysis, and interpretation, and original draft preparation. JR: Conceptualization, Supervision, Validation, Data analysis, Funding acquisition. RK: Conceptualization, Methodology, data interpretation, and validation.

ETHICAL CONSIDERATION

This study protocol was approved by the Institutional Review Board, Faculty of Nursing, Mahidol University (COA No. IRB.NS2023/805.1209) and the BMA Human Research Ethics Committee, project number IRB-NS NS2023/48.2906, on 12 September 2023. Before providing written informed consent, participants received an explanation of the experimental procedure, risks, and benefits. The information was kept confidential and was not disclosed to the public individually. The results were reported in aggregate form for educational purposes only.

FUNDING

The authors appreciate the support provided by the public health volunteers who greatly participated in this study and thank the Faculty of Graduate, Mahidol University, for the partial funding support.

REFERENCE

1. International Diabetes Federation. Diabetes Atlas 10th ed. 2021. [Cited 2022 July 15]. Available from: https://diabetesatlas.org/idfawp/resourcefiles/2021/07/IDF_Atlas_10th_Edition_2021.pdf
2. Division of Non-Communicable Diseases, Department of Disease Control, Ministry of Public Health, Thailand. Guidelines for remission service in people with diabetes Ministry of Public Health. 2023.
3. Health Data Center. New cases of diabetes 2023. [cited 2023 July 28]. Available from: https://hdcservice.moph.go.th/hdc/reports/report.php?source=pformated/format1.php&cat_id=6a1fdf282fd28180eed7d1cfe0155e11&id=eeeab22e386d32e7f5f5ecefebce0001#
4. Sthiraphon B. Pathophysiology of diabetic nephropathy. In: Anutrakulchai S, Chancharoenthana W, Kittisakunnam P, Trakarnwanich T, Ditsabunchong S, Opascharoensuk W, editors. Textbook of Chronic Kidney Disease. 3rd ed. Bangkok: Text and Journal Publication; 2023; p. 238-60.
5. Kawamura T, Yunihiro K, Kouzuki M, Tomino Y. One hundred and fifty kidney disease questions. 1 st ed. Bangkok: Nanmee Books: 2022; p. 44-77.
6. Shichiri M, Kishikawa H, Ohkubo Y, Wake N. Long-term results of the Kumamoto Study on optimal diabetes control in type 2 diabetic patients. Diabetes Care. 2000; Apr;23: 21-9. [Cited 2023 July 15]. Available from:

https://pubmed.ncbi.nlm.nih.gov/10860187/
7. Stratton IM, Adler AI, Neil HA, Matthews DR, Manley SE, Cull CA, Hadden D, Turner RC, Holman RR. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. BMJ. 2000; Aug 12;321(7258): 405-12. doi: 10.1136/bmj.321.7258.405. [Cited 2023 July 15]. Available from: https://pubmed.ncbi.nlm.nih.gov/10938048/
8. American Diabetes Association. *Standards of Medical Care in Diabetes-2017* Abridged for Primary Care Providers. *Clin Diabetes.* 2017; 35 (1): 5-26. Available from: https://doi.org/10.2337/cd16-0067
9. Cooper H, Booth K, Gill G. A trial of empowerment-based education in type 2 diabetes-global rather than glycaemic benefits. Diabetes Res Clin Pract. 2008;82(2):165-71. doi:10.1016/j.diabres.2008.07.013. [Cited 2023 July 15]. Available from: https://pubmed.ncbi.nlm.nih.gov/18804887/.
10. Klug C, Toobert DJ, Fogerty M. Healthy Changes for living with diabetes: an evidence-based community diabetes self-management program. Diabetes Educator. 2008; 34(6): 1053-61. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4908955/
11. Krebs JD, Parry A, Gamble E, McBain L, Bingham LJ, Dutton ES, Tapu S, Howells J, Metekingi H, Smith RB, Coppell KJ. A structured, group-based diabetes self-management education (DSME) programme for people, families and whanau with type 2 diabetes (T2DM) in New Zealand: an observational study. Primary Care Diabetes. 2013; 7(2): 151-8. Available from: https://pubmed.ncbi.nlm.nih.gov/23517821/
12. Boonnak P. Pathophysiology of diabetic nephropathy. In: Anutrakulchai S, Chancharoenthana W, Kittisakunnam P, Trakarnwanich T, Ditsabunchong S, Opascharoensuk W, editors. Textbook of Chronic Kidney Disease. 3rd ed. Bangkok: Text and Journal Publication. 2023; p. 899-914.
13. Rattanasri P. Effects of a Self-Management Support Program on Self-Management Behaviors and Clinical Outcomes to Delay Kidney Failure in Type 2 Diabetic Patients at Samran Subdistrict Health Promotion Hospital. J of Khon Kaen Provincial Health Office. 2022; 4(2): 209-224.
14. Wongpipit W, Kritpet T, Pongpiboon S. Physical activity and sedentary behavior. J Sports Sci Health. 2021; 21(1):1-21.
15. Phanwattana P. Food consumption behavior of urban working people in Bangkok. J of 7th Disease Control Office, Khon Kaen. 2019; 26(2): 93-102.Available from: https://he01.tci-thaijo.org/index.php/jdpc7kk/article/view/212982
16. Ratanophas W. Food consumption behavior of people in Khlong Phikhai Subdistrict, Phran Kratai District, Kamphaeng Phet Province. Rajabhat Rambhai Barni Research J. 2022; 16(1): 58-65.
17. Health Promotion Division, Health Department, Bangkok Metropolitan. Readiness training for Bangkok Metropolitan public health volunteers. 2021. [cited 2023 November 10]. Available from: www.bankok.go.th/health.
18. Nukoonkit S, Sareerattana T. Effects of a health promotion program in combination with group process in the self-care behavior modification of patients with type 2 diabetes at

community health centers, Mueang, Sakon Nakhon Province. J Sakon Nakhon Hosp. 2018;21(1):77-86.
19. Toobert DJ, Strycker LA, King DK, Barrera MJ, Osuna D, Glasgow RE. Long-term outcomes from a multiple-risk-factor diabetes trial for Latinas: ¡Viva Bien!. Transl Behav Med. 2011; Sep;1(3): 416-26. doi: 10.1007/s13142-010-0011-1. [Cited 2023 July 15]. Available from: https://pubmed.ncbi.nlm.nih.gov/22022345/
20. Jiamjarasrangsi W. Type 2 Diabetes. Bangkok: Chulalongkorn University Printing: 2018.
21. Allegrante JP, Wells MT, Peterson JC. Interventions to support behavioral self-management of chronic diseases: Annual review of public health. 2019; 40:127-46. [Cited 2023 July 15]. Available from: https://www.annualreviews.org/content/journals/10.1146/annurev-publhealth-040218-044008
22. Chen L, Chuang LM, Chang CH, Wang CS, Wang IC, Chung Y, et al. Evaluating self-management behaviors of diabetic patients in a telehealth care program: Longitudinal study over 18 months. J Med Internet Res. 2013; 15(12): e266. doi: 10.2196/jmir.2699. [Cited 2023 July 15]. Available from: https://pubmed.ncbi.nlm.nih.gov/24323283/
23. Chaipan N, Boonkla S, Konhan K, Chaipan N. Handbook on the process of building health literacy in preventing and controlling disease and health hazards. 1st ed. Department of Disease Control, Bureau of Risk Communication and Health Behavior Development; 2021. [cited 2023 July 15]. Available from: https://ddc.moph.go.th/uploads/publish/1188920211018040126.pdf
24. Silpawittayathorn B, Chitpakdee B. The use of health information technology in nursing for patient safety. J of Nursing and Health Care. 2020; 8(2): 6-14.
25. Demkhuntod N, Kwancharoen R, Chuantantikamon C, Phaholpak P, Suromrakul S. The effect of telehealth monitoring on blood sugar control and medication adherence in poorly controlled type 2 diabetes patients. Wachirawet J Urban Med. 2021:75-90.
26. Srisuk P, Methakanjanasuck N. Effects of an internet-based self-management program for dietary carbohydrate control and promotion of exercise in patients with type 2 diabetes. Udonthani Hosp Med J. 2021;30(1):12-20.
27. Yingyuen K, Methakanjanasuck N. Self-management innovations via a telehealth system for patients with type 2 diabetes and hyperlipidemia. Srinagarind Med J. 2016; 31(6): 365-71.
28. Cotter AP, Durant N, Agne AA, Cherrington AL. Internet interventions to support lifestyle modification for diabetes management: a systematic review of the evidence. J Diabetes Complications. 2014; 28(2): 243-51. [Cited 2023 July 15]. Available from: https://pubmed.ncbi.nlm.nih.gov/24332469/
29. Liang X, Wang Q, Yang X, Cao J, Chen J, Mo X, Huang J, Wang L, Gu D. Effect of mobile phone intervention for diabetes on glycaemic control: a meta-analysis. Diabet Med. 2011; 28(4): 455-63. [Cited 2023 July 15]. Available from: https://pubmed.ncbi.nlm.nih.gov/21392066/
30. Lorig K, Ritter PL, Laurent DD, Plant K, Green M, Jernigan VB, Case S. Online diabetes self-management program: a randomized study. Diabetes Care. 2010; Jun; 33(6): 1275-81. doi: 10.2337/dc09-2153. [Cited 2023 July 15]. Available from: https://pubmed.ncbi.nlm.nih.gov/20299481/
31. Elgaphar SM, El Gafar SI. Effect of tele-nursing (phone-based follow-ups) on self-efficacy, healthy lifestyle, and glycemic control in diabetic patients. IOSR-JNHS. 2017; 6(3): 67-76. [Cited 2023 July 15]. Available from: https://www.iosrjournals.org/iosr-

jnhs/papers/vol6-issue3/Version-5/J0603056776.pdf
32. Hadjiconstantinou M, Byrne J, Bodicoat DH, Robertson N, Eborall H, Khunti K, Davies MJ. Do web-based interventions improve well-being in type 2 diabetes? a systematic review and meta-analysis. J Med Internet Res. 2016; 8(10): 270. doi: 10.2196/ jmir.5991. [Cited 2023 July 15]. Available from: https://pubmed.ncbi. nlm.nih.gov/27769955/
33. Gulavani SS, Kulkarni M. Role of Social Media in Marketing in 21st Century. J of the Maharaja Sayajirao University of Baroda. 2022; 56(1): 75-84.
34. Boonchan S, Phongpattanawut S. The effect of providing knowledge on carbohydrate counting with telephone follow-up on blood sugar level in type 2 diabetic patients at Phaholyothin Pholpayuhasena Hospital, Kanchanaburi Province. J of Nutrition. 2018; 53(2): 71-83. Available from: http://www.Nutritionthailand.org
35. Lorig KR, Holman H. (2003). Self-management education: History, definition, outcomes, and mechanisms. Ann Behav Med. 2003; 26(1):1-7. doi: 10.1207/S15324796ABM2601_01. [Cited 2023 July 15]. Available from: https://pubmed.ncbi.nlm.nih.gov/12867348/
36. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. NJ: Lawrence Erlbaum Associates, Publishers; 1988.
37. Sonketsarin A, Chantra R, Kwanchum R, Rueangduang L. The effect of a health behavior modification program according to the 3A.2S. approach of public health volunteers (PHVs) in Khlong Chanak Subdistrict, Mueang District, Surat Thani Province. J South Nurs Coll Public Health Network. 2017;4(1):253-64.
38. Aranyasan D, Seesuree Y, Chumnanborirak P. Effects of health behavior changing program on slowly progressive chronic kidney disease in patients with diabetes mellitus and hypertension at Koeng health promotion hospital, Mueang Mahasarakham District, Mahasarakham Province. Academic J Mahasarakham Prov Public Health Off. 2020;1-12.
39. Yoomuang P. Application-based model supporting self-management for patients with stage 3 chronic kidney disease. Phitsanulok: Narasuan University; 2022.
40. Boonthanapisan N, Naewbood S, Tipwareerom W. Effect of self-management promotion program using LINE application on health behaviors and A1C levels among uncontrolled diabetic patients. J Nurs Health Sci. 2022;16(3):47-59.
41. Sritong W, Methakanchanasak N. The effect of a self-management program with LINE reminders to prevent fluid overload in hemodialysis patients. J Nurs Sci Health. 2021;44(4):1-16.
42. Sabai Suk N, Suphametaporn P, Songthai N. Effects of a self-management support program on health behavior and glomerular filtration rate in patients with type 2 diabetes mellitus with chronic kidney disease stage 3. J Boromarajonani Coll Nurs Uttaradit. 2018;(Special Issue):137-50. [cited 2023 July 15]. Available from: https://he01.tci-thaijo.org/index.php/unc/article/view/152763
43. Dankasai C, Limtrakul P. Delaying renal degeneration in patients with diabetes and renal complications in communities: Phra Klang Thung That Phanom, Nakhon Phanom. J Nurs Health Care. 2016;34(2):6-12.
44. Sitkunanan P, Kamthip P. Impact of a self-management programme monitored

through the application LINE on eating behaviour, arm-swing exercise behaviour, and blood glucose levels in women with gestational diabetes mellitus. J Thailand Nurs Midwifery Counc. 2020;35(2):52-69.
45. Thailand Nusring and Midwifery Council. Tele-Nursing Guidelines. 2021. [Cited 2023 July 15]. Available from: https://ratchakitcha.soc.go.th/documents/17157975.pdf
46. Koshakri, R. Rerkluenrit J. Effectiveness of the Thai traditional health tourism activities empowerment program on the active aging of Thai older adults. J Public Hlth Dev. 2024; 22(2):286-296. [Cited 2024 Oct 15]. Available from: https://doi.org/10.55131/jphd/2024/220217
47. Yingyuen K, Methakanjanasuck N. Self-management innovations via a telehealth system for patients with type 2 diabetes and hyperlipidemia. Srinagarind Med J. 2016; 31(6): 365-71.
48. Trisirichoke P, Utharasat L, Kaenkan W. The effect of self-management support by a multidisciplinary team to delay chronic kidney disease in primary care units of Khon Kaen Hospital. Srinagarind Med J. 2019; 34(6): 552-8.