

Telehealth Potential to Optimize Self-Management, Education, and Support for Diabetes Mellitus Patients during COVID-19 Pandemic

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Article information

Article history:

Received: December 30th, 2021

Revised: March 12th, 2022

Accepted: March 28th, 2022

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International Journal of Nursing and Health Services (IJNHS)

Volume 5, Issue 2, April 20th, 2022

DOI: 10.35654/ijnhs.v5i2.557

E-ISSN: 2654-6310

Abstract

Background: The limited physical interaction policy during the COVID-19 pandemic and concerns of DM patients visiting healthcare facilities cause routine visits delays, treatment discrepancies, and ineffective health education. Telehealth can provide DM patients convenience of self-management during pandemics.

Objective: This review aims to discover the potential use of telehealth to optimize Self-Management, Education, and Support for DM patients during the COVID-19 pandemic. **Method:** Rapid review has been done by conducting a systematic search on five databases: PubMed, EBSCO-host Academic Science Completed, ScienceDirect, Sage Journals, and Taylor and Francis. The articles have been identified through the following criteria: the year of publication is at most two years old (2019-2021), the research design used is strictly Randomized Control Trial and Quasi Experiment, and the published language must be English. **Results:** It was found that some telehealth-based interventions, such as remote monitoring of independent blood glucose levels, education through text messaging, telephone, and Technological Surrogate Nursing (TSN), can effectively facilitate self-management of patients with diabetes. The main features mentioned are reminders, automatic data processing systems, education in the form of modules and videos, and call center services for regular follow-ups. Telehealth is an online-based health service that has the potential to optimize the self-management of DM patients.

Keywords: diabetes mellitus, telehealth, self-management

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INTRODUCTION

Coronavirus Disease 2019 (COVID-19) is an infectious disease caused by the SARS-CoV-2 coronavirus (severe acute respiratory syndrome - Coronavirus-2). This pathogen was first identified in Wuhan, China, on December 31st, 2019, and was announced a pandemic on March 11th, 2020 (1). There were at least more than 46 million confirmed cases of COVID-19 as of August 18th, 2021, with a total of 750,476,000 deaths worldwide (2). This number is dominated by patients with comorbidities such as hypertension, cardiovascular and cerebrovascular disorders, and diabetes mellitus (DM) (3).

Patients with a history of DM make up a significant proportion of all hospitalized COVID-19 patients (3). Epidemiological evidence shows that COVID-19 is 50% more likely to endanger DM patients than non-DM patients (4). In addition, DM patients also tend to show a poorer prognosis for SARS-CoV-2 infection and thus require intensive care (5). Although no research has established DM as an independent factor that can increase the development of COVID-19 symptoms, complications from this disease may inevitably worsen the condition (6). Thus, it is essential to modify other complications of DM by performing glycemic control (6).

The DM management system currently relies heavily on regular face-to-face consultations in outpatient clinics (7). One government program that is still implementing this system is the Chronic Disease Management Program (PROLANIS) from BPJS Kesehatan. Several activities available in PROLANIS, such as health status monitoring, club activities, and medical/educational consultations, are carried out face-to-face (8). Other activities, such as regular remote reminders via SMS, are only intended to increase the motivation of PROLANIS participants to make regular visits to health facilities (8). This condition caused the program to run less optimally due to physical distancing policies during the pandemic.

The COVID-19 pandemic also presents its challenges for DM patients as a vulnerable

population. Policies about limiting physical interaction and concerns from DM patients to visit health care facilities cause routine-visits delays, treatment discrepancies, and ineffective health education (6,9). In addition, unhealthy lifestyles during the pandemic, such as lack of exercise, irregular eating patterns, and poor self-management abilities of DM patients, make controlling blood sugar levels more difficult (9). Successful management of DM can be achieved through self-management and good education (10,11). This process facilitates DM patients' knowledge, skills, and abilities in performing diabetes care (12). The study results prove that self-management and education can reduce hemoglobin A1c (HbA1c) levels and have a positive impact on clinical, psychosocial, and behavioral aspects of DM patients (13).

Along with the development of technology and information, the health services delivery process can be simplified with telehealth (14). Telehealth is a long-distance service that can remotely access health services, including in remote areas (15). Telehealth services use telephone calls, remote monitoring, and photo and video transmission (both real-time and store-and-forward (16). This feature allows users to exchange information effectively without physical interaction.

The use of telehealth in diabetes management activities can help DM patients achieve better health outcomes (9). The results showed that DM patients who participated in remote diabetes management programs experienced a significant decrease in average body weight and a better average decrease in hemoglobin A1c (HbA1c) levels than the non-telehealth group (17). In addition, efficiency (in terms of time and cost) can be obtained by DM patients by utilizing remote services (18). Therefore, telehealth services are an effective and affordable option (19).

The availability of electronic devices and good quality of connectivity allows telehealth services to expand widely (16). Data gathered within 2019-2020 from the Indonesian Internet Service Providers Association (APJII) shows

that internet usage penetration in Indonesia has reached 73.7%, with 196,714,070 users (20). This fact provides a positive signal for telehealth in the self-management of DM patients during the pandemic

OBJECTIVE

This literature review aims to determine the potential use of telehealth in improving self-management, education, and support for DM patients during the COVID-19 pandemic.

METHOD Protocol

The design used in this literature is a rapid review. Rapid review simplifies a systematic review with a quick review method. In general, an immediate review is handled within eight weeks. The rapid review has been proposed to provide timely and resource-efficient literature summaries. It uses methods to speed up the search by excluding gray literature or non-commercial publications or narrowing the review's scope using constraints such as year and language (21). This design is suitable for dealing with emergency and urgent situations such as the COVID-19 pandemic.

Sample & Sampling Technique

Sample selection uses the accidental sampling technique with the sample number expected to meet 50 respondents. The inclusion criteria for respondents are postpartum mothers with live births, early stages of postpartum (> 24 hours to 1 week), postpartum mothers who agreed to be respondents, and postpartum mothers without complications. Exclusion criteria are mothers with newborns hospitalized because of illness in the postpartum period and mothers with newborns who have innate abnormalities. Data retrieval was carried out for six months by looking for respondents according to the criteria

Eligibility Criteria

This literature review uses the 2020 PRISMA Flow Diagram and is criticized using

The Joanna Briggs Institute (JBI) Critical Appraisal to assess the feasibility of the selected articles. An article is deemed feasible if it meets >60% of the assessment. The synthesis of the data results is own in Table 1
Table 1. PICO's Search Strategy

PICO's Framework	Search Strategy
Populations	Diabetes mellitus OR Diabetic
Intervention	Telehealth OR Telemedicine OR eHealth OR Telenursing
Comparison	-
Outcomes	Self-management OR Self-care
Studies	RCT and Quasi-Experimental

Search Strategy

Based on a comprehensive search of articles from 5 databases, 588 articles were identified based on combining keywords with the application of the PICO approach. The inclusion criteria in this literature review were free full-text articles published in the last two years (2019 - 2021) with an experimental research design and published in English

Study Selection

Article searches were carried out systematically according to the 2020 PRISMA Flow Diagram based on five databases used, namely PubMed, EBSCO-host Academic Science Completed, ScienceDirect, Sage Journals, and Taylor and Francis

Synthesis of Results

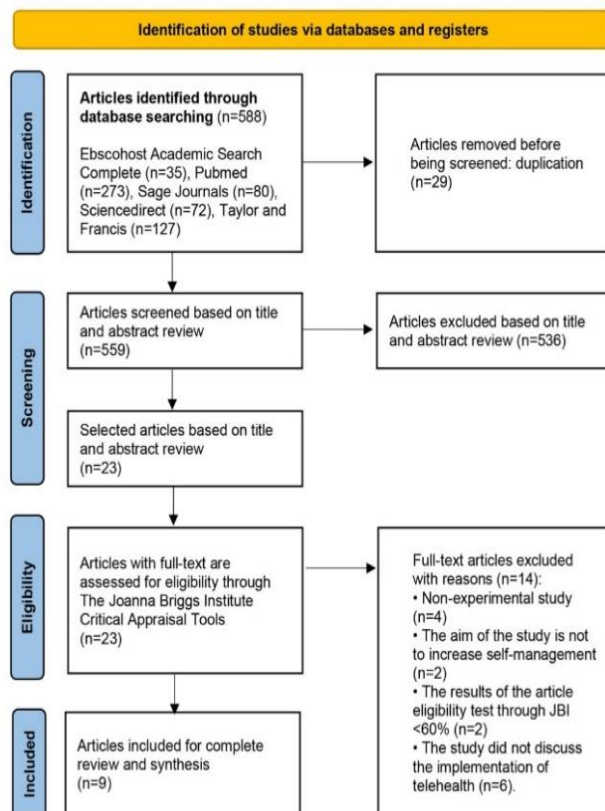
The findings of this review describe and explain the optimization and use of telehealth to support self-management for DM patients during the COVID-19 pandemic.

RESULTS

Study Characteristic

A total of 588 articles were retrieved

from 5 databases. Initial search results included 35 EBSCOhost Academic Search Completed journals, 273 PubMed journals, 80 Sage Journals, 72 ScienceDirect journals, and 127 Taylor and Francis journals. This study covers several aspects, such as the year of publication, research design, research objectives, population, interventions, and conclusions. However, 579 articles were



excluded due to objective irrelevance. Articles with full text are assessed for eligibility through the JBI Critical Appraisal Checklist. Finally, with Randomized Controlled Trial (RCT) research design, the nine most relevant articles were selected for this study

Figure 1. PRISMA Flow Diagram

Table 2. Study Included with JBI Critical Appraisal Tool

Author, Published Year	JBI Critical Appraisal Checklist 2017	Study Design
Yang et al., 2020	69.2%	RCT
Parsons et al., 2019	61.5%	RCT

Odom et al., 2019	61.5%	RCT
Lee et al., 2020	69.2%	RCT
Zhang et al., 2019	69.2%	RCT
Xu et al., 2020	84.6%	RCT
Or et al., 2020	69.2%	RCT
Sun et al., 2019	69.2%	RCT
Amante et al., 2021	61.5%	RCT

The selected nine articles discussed several interventions, namely telehealth-based self-monitoring of blood glucose levels, self-management education via text messages, telephone, and applications, and Technological Surrogate Nursing (TSN) effectivity in improving glycemic control and self-management skills. The studies came from the following countries: China (n=2), Hong Kong (n=1), South Korea (n=2), the United Kingdom (n=1), and the United States (n=3). All studies focused on telehealth-based blood glucose monitoring interventions with sample sizes ranging from 50 to 446 participants.

Telehealth Roles in Self-Management, Education, and Support

Diabetes is a non-communicable disease that requires long-term self-management skills. Educational programs and self-management support become an essential requirement for DM patients to guide disease management (22). The use of telehealth in self-management activities of DM patients has been shown to provide better results than the non-telehealth group (17). Good self-management is proven to reduce the chances of hospitalization of DM patients and medical expenses and improve health status (13,23). Thus, telehealth is an effective method to facilitate self-management, education, and support for DM patients during a pandemic

1. Remote Self-monitoring Blood Glucose Level

Self-monitoring blood glucose (SMBG) is one way to improve glycemic control in DM patients (24). Currently, SMBG can be

performed with telehealth via remote instructions and data input into the system. The procedure for checking blood glucose can be done in two ways: using a manual glucometer and near field communication (NFC) or Bluetooth glucometer. It is automatically connected to a smartphone. The measurement results are then uploaded via a wireless network for further analysis by health workers (7,25,26). This information will be the basis for health workers in providing services according to their needs (27,28). Based on the results of several articles, it is known that telehealth-based SMBG can improve glycemic control in DM patients, which is characterized by a significant decrease in HbA1c and postprandial blood glucose levels (7,25,26).

2. Diabetic Education Program

Education is an action in changing the attitudes and behavior of individuals and groups through training and teaching. Diabetes self-management education consists of self-care, medication, physical activity, diet, and stress management (7,25,26). This self-management education can be accessed via phone calls, text messages, and specific applications (29). Providing education through the application has several advantages: providing automatic telephone and SMS services, recording patient health data, and then processing it into simpler information (7,25,26,29). In addition, patients can also receive message-based education containing general information about diabetes management (29-30). Based on the results from several articles, education through messages can improve DM patients' glycemic status and self-management skills (7,25).

3. Technological Surrogate Nursing (TSN)

TSN is a technology-based nursing substitution service that aims to facilitate DM patients to perform care independently. The features available in this TSN include DM-management-related video courses and modules in text form and voice reminders, which can be accessed as needed. The results of a study conducted on 299 DM patients showed that TSN was safe to use without the

assistance of health workers and was influential in lowering HbA1c levels (26)

DISCUSSION

The COVID-19 pandemic has significantly impacted the prevention and treatment of non-communicable diseases, especially for DM patients. The policy of limiting physical interaction and the risk of spreading the virus in health care facilities causes DM patients to postpone routine care schedules (6). In addition, unhealthy lifestyles during the pandemic and poor self-management skills may lead to uncontrollable blood glucose levels (9). This can trigger complications and exacerbate COVID-19 infection in DM patients (6). Thus, it is essential to reassure the DM patient about services that can facilitate self-management, education, and support during a pandemic.

The primary function of telehealth is to help exchange information remotely through electronic media connected to systems and networks. In this context, the information conveyed is information on self-management programs from health workers and independent control data from DM patients. Various types of telehealth media developed based on the results of this study are automatic blood glucose checking tools, telephone calls, text messaging services, and mobile application.

Telehealth is effective in facilitating self-management programs in DM patients through remote blood glucose monitoring and education. It is known that telehealth-based Self-monitoring Blood Glucose (SMBG) and education on diabetic care can improve glycemic control in DM patients, which is characterized by a significant decrease in HbA1c and postprandial blood glucose levels (7,25,26). Although several relevant studies have shown that telehealth is quite effective in facilitating the self-management of DM patients, there are certain limitations to this method. The use of interactive services and applications combined with SMBG is considered more effective in supporting glycemic management in DM patients. However, it should be noted that long-term improvement in glucose levels cannot be

achieved by using the application independently but requires remote interaction with other professions (25).

The service features that need to be available and further developed are independent blood glucose monitoring tools, reminders, automatic data processing systems, education in the form of modules and videos, and call center services to facilitate direct interaction between DM patients and health workers. Through this feature, DM patients will get complete information regarding self-management and make it easier to carry out periodic control without visiting health facilities directly. Thus, physical contact can be minimized, and the spread of COVID-19 can be prevented.

CONCLUSION

Our analysis shows that telehealth has good potential to facilitate self-management for DM patients. This technology is proven to reduce blood glucose levels in DM patients (postprandial and HbA1c) effectively through education programs and remote monitoring. Telehealth, which involves minimal physical contact, can also reduce the risk of spreading coronavirus. Several types of research show that the long-term benefits of telehealth are challenging to maintain unless there is the regular follow-up from health workers. This procedure can be done by phone call or text message.

Therefore, we recommend using telehealth in conjunction with remote supervision of health workers to optimize self-management programs for DM patients. In addition, further research is needed to determine the effectiveness of using this technology in facilitating the self-management of DM patients during the pandemic, especially in the context of Indonesian society

LIMITATION

This research is limited to telehealth implementations that can help DM patients carry out self-management during the pandemic. This study is focused on the effectiveness of each method by considering the needs of DM patients. It is possible that some promising results from other studies

were overlooked or did not appear during the database search. Further studies are required to dictate the effectiveness of telehealth while especially adhering to the Indonesian cultural values. Expanding the search scope, such as database enrichment and hand-searching, may help researchers with article processing

Acknowledgment

The authors consist of all individuals who had sufficient competence until the completion of this study and were actively contributing. The authors would like to express their utmost gratitude to Padjadjaran University and the Faculty of Nursing of Padjadjaran University, which facilitated database searches and supervised the compilation process of this study.

REFERENCES

- (1) World Health Organization. Rolling updates on coronavirus disease (COVID-19) [Internet]. 2020 [cited 2021 Oct 13]. Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen>
- (2) GAVI The Vaccine Alliance. Responding to COVID-19 [Internet]. [cited 2021 Oct 13]. Available from: https://www.gavi.org/covid19gclid=CjwKCAjwgviIBhBkEiwA10D2j37REld1eu95mDRSX rzgSSCKaX2EAB5dpiljl-37XKNK_oAoVBvWvRoChckQAvD_BwE
- (3) Peric S, Stulnig TM. Diabetes and COVID-19: Disease-Management-People. *Wien Klin Wochenschr.* 2020 Jul;132(13-14):356-61.
- (4) Remuzzi A, Remuzzi G. COVID-19, and Italy: what next? *Lancet* (London, England). 2020 Apr;395(10231):1225-8.
- (5) Li B, Yang J, Zhao F, Zhi L, Wang X, Liu L, et al. Prevalence and impact of cardiovascular, metabolic diseases on COVID-19 in China. *Clin Res Cardiol.* 2020 May;109(5):531-8.
- (6) Selvin E, Juraschek SP. Diabetes Epidemiology in the COVID-19 Pandemic. *Diabetes Care.* 2020 Aug;43(8):1690-4.

- (7) Yang Y, Lee EY, Kim H-S, Lee S-H, Yoon K-H, Cho J-H. Effect of a Mobile Phone-Based Glucose-Monitoring and Feedback System for Type 2 Diabetes Management in Multiple Primary Care Clinic Settings: Cluster Randomized Controlled Trial. *JMIR mHealth uHealth*. 2020 Feb;8(2):e16266.
- (8) BPJS Kesehatan. Panduan Praktis PROLANIS: Program Pengelolaan Penyakit Kronis [Internet]. 2014 [cited 2021 Oct 13]. Available from: <https://bpjs-kesehatan.go.id/bpjs/dmdocuments/06-PROLANIS.pdf>
- (9) Kang J, Chen Y, Zhao Y, Zhang C. Effect of remote management on comprehensive management of diabetes mellitus during the COVID-19 epidemic. *Prim Care Diabetes* [Internet]. 2021;15(3):Nourazari, S., Davis, S. R., Granovsky, R., Austin.
- (10) American Diabetes Association. 4. Lifestyle Management: Standards of Medical Care in Diabetes-2018. *Diabetes Care*. 2018 Jan;41(Suppl 1): S38–50.
- (11) Kim HS, Kim H, Yang HK, Lee EY, Jeong YJ, Kim TM, et al. Physician-Directed Diabetes Education without a Medication Change and Associated Patient Outcomes. *Diabetes Metab J*. 2017 Jun;41(3):187–94.
- (12) Powers MA, Bardsley J, Cypress M, Duker P, Funnell MM, Fischl AH, et al. Diabetes Self-management Education and Support in Type 2 Diabetes: A Joint Position Statement of the American Diabetes Association, the American Association of Diabetes Educators, and the Academy of Nutrition and Dietetics. *Clin Diabetes*. 2016 Apr;34(2):70–80.
- (13) Siminerio L, Ruppert K, Huber K, Toledo FGS. Telemedicine for Reach, Education, Access, and Treatment (TREAT): linking telemedicine with diabetes self-management education to improve care in rural communities. *Diabetes Educ*. 2014;40(6):797–805.
- (14) World Health Organization. Telemedicine: opportunities and developments in the Member States: report on the second global survey on eHealth [Internet]. 2010 [cited 2021 Oct 13].
- (15) Ariyanti S, Kautsarina K. Kajian Tekno-Ekonomi pada Telehealth di Indonesia. *Bul Pos dan Telekomun*. 2017;15(1):43.
- (16) Mahoney MF. Telehealth, Telemedicine, and Related Technologic Platforms: Current Practice and Response to the COVID-19 Pandemic. *J wound, ostomy, Cont Nurs Off Publ Wound, Ostomy Cont Nurses Soc*. 2020;47(5):439–44.
- (17) Heitkemper EM, Mamykina L, Travers J, Smaldone A. Do health information technology self-management interventions improve glycemic control in medically underserved adults with diabetes? A systematic review and meta-analysis. *J Am Med Inform Assoc*. 2017 Sep;24(5):1024–35.
- (18) Lee JY, Lee SWH. Telemedicine Cost-Effectiveness for Diabetes Management: A Systematic Review. *Diabetes Technol Ther*. 2018 Jul;20(7):492–500.
- (19) Monaghesh E, Hajizadeh A. The role of telehealth during COVID-19 outbreak: a systematic review based on current evidence. *BMC Public Health*. 2020 Aug;20(1):1193.
- (20) Asosiasi Penyelenggara Jasa Internet Indonesia. Laporan Survei Internet APJII 2019-2020-(Q2) [Internet]. 2020. Available from: <https://apjii.or.id/survei>
- (21) Moons P, Goossens E, Thompson DR. Rapid reviews: the pros and cons of an accelerated review process. *Eur J Cardiovasc Nurs*. 2021;20(5):515–9.
- (22) Brunisholz KD, Briot P, Hamilton S, Joy EA, Lomax M, Barton N, et al. Diabetes self-management education improves the quality of care and clinical outcomes determined by a diabetes bundle measure. *J Multidiscip Healthc*. 2014;7:533–42.
- (23) Healy SJ, Black D, Harris C, Lorenz A, Dungan KM. Inpatient diabetes education is associated with less frequent hospital readmission among patients with poor glycemic control. *Diabetes Care*. 2013 Oct;36(10):2960–7.
- (24) Parsons SN, Luzio SD, Harvey JN, Bain

- SC, Cheung WY, Watkins A, et al. Effect of structured self-monitoring of blood glucose, with and without additional TeleCare support, on overall glycaemic control in non-insulin treated type 2 diabetes: the SMBG Study, a 12-month randomized controlled trial. *Diabet Med.* 2019 May;36(5):578–90.
- (25) Zhang L, He X, Shen Y, Yu H, Pan J, Zhu W, et al. Effectiveness of Smartphone App-Based Interactive Management on Glycemic Control in Chinese Patients With Poorly Controlled Diabetes: Randomized Controlled Trial. *J Med Internet Res.* 2019 Dec;21(12):e15401.
- (26) Or CK, Liu K, So MKP, Cheung B, Yam LYC, Tiwari A, et al. Improving Self-Care in Patients With Coexisting Type 2 Diabetes and Hypertension by Technological Surrogate Nursing: Randomized Controlled Trial. *J Med Internet Res.* 2020 Mar;22(3):e16769.
- (27) Odom JM, Stancil M, Nelson B, Russell-Sellers R, Schwecke N, Dawson J, et al. Improving Diabetes Control Through Remote Glucose Monitoring in a Diabetes Self-Management Program for Employees of a Health System. *Clin Diabetes.* 2019 Jul;37(3):203–10.
- (28) Sun C, Sun L, Xi S, Zhang H, Wang H, Feng Y, et al. Mobile Phone-Based Telemedicine Practice in Older Chinese Patients with Type 2 Diabetes Mellitus: Randomized Controlled Trial. *JMIR mHealth uHealth.* 2019 Jan;7(1):e10664.
- (29) Pamungkas RA, Chamroonsawasdi K. Self-management based coaching program to improve diabetes mellitus self-management practice and metabolic markers among uncontrolled type 2 diabetes mellitus in Indonesia: A quasi-experimental study. *Diabetes & Metabolic Syndrome: Clinical Research & Review.* 2020; 14(1): 53-61
- (30) Pamungkas RA, Chinnawong T, Kritpracha C. The effect of dietary and exercise self-management support program on dietary behavior, exercise behavior, and clinical outcomes in Muslim patients with poorly controlled type 2 diabetes mellitus. *Nurse Media*

Table 3. Data Extraction

No	Author Name, Year Published	Title	Objectives	Method	Sample	Intervention	Result
1.	Yang et al., 2020	Effect of a Mobile Phone-Based Glucose-Monitoring and Feedback System for Type 2 Diabetes Management in Multiple Primary Care Clinic Settings: Cluster Randomized Controlled Trial	To evaluate the implementation of the mobile application for blood glucose monitoring in type 2 diabetes mellitus patients in primary health care settings.	RCT	Initially, from 17 clinics, four clinics refused to participate. And 13 were randomized. And 13 clinics were allocated from 2:1 to 9:4. Existing sample = 150 (9 clinics) and 97 (4 clinics)	The control group received a face-to-face doctor's consultation intervention at the clinic. In contrast, the intervention group was asked to self-monitor blood glucose and upload the results via an application (Hicare competent K). Both groups carried out the intervention for three months.	Blood glucose monitoring and feedback systems through mobile applications have been proven to improve glycemic control in various primary health care institutions.
2.	Parsons et al., 2019	Effect of Structured Self-Monitoring of Blood Glucose, with and Without Additional TeleCare Support, on Overall Glycaemic Control in Non-insulin Treated Type 2 Diabetes: the SMBG Study, a 12-month Randomized Controlled Trial	To examine the impact of structured self-monitoring of blood glucose, with or without TeleCare support, on glycemic control in people with poorly controlled type 2 diabetes.	RCT	Four hundred forty-six participants were randomized to a control group (n = 151) who received usual diabetes care, a group using structured blood glucose monitoring alone (n = 147), or a group using structured blood glucose monitoring with additional monthly 'TeleCare' support (n = 148).	Group 1 received the usual care. Group 2 received education and support with the booklet 'Your Guide to Type 2 Diabetes. Group 3 received the SMBG intervention, and TeleCare was contacted by telephone at an agreed time each month. The duration of the intervention was three months.	Structured self-monitoring of blood glucose provides clinical and statistical improvements in glycemic control in type 2 diabetes.
3.	Odom et al., 2019	Improving Diabetes Control Through Remote Glucose Monitoring in a Diabetes Self-Management Program for	To investigate diabetes education, telehealth, wireless-enabled meters, and treatment	RCT	50 patients referred from the health system primary care practice and endocrinology office	Diabetes self-management education (DSME) with remote monitoring by phone, text, email, measuring message, or in person at least every 2-4 weeks	Demonstrate improved diabetes control using new technology to provide remote monitoring and telehealth that

		Employees of a Health System	algorithms to improve care for a target population of employees with type 1 or type 2 diabetes.				enhances the outreach and education provided in diabetes self-management programs.
4.	Lee et al., 2020	Effect of Voluntary Participation on Mobile Health Care in Diabetes Management: Randomized Controlled Open-Label Trial	To evaluate the health-based self-management education program for diabetic patients and see the effect of participant volunteerism.	RCT	Participants were recruited voluntarily from Kangbuk Samsung Hospital. Participants were then divided into two groups, namely the control group (n=31) and the intervention group (n=41).	The intervention group received mHealth-based diabetes self-management education through the application and received personalized feedback from the health professional in charge. Meanwhile, the control group was instructed to maintain the diabetes management activities they had previously implemented. Both groups underwent the intervention for six months.	mHealth-based diabetes self-management education was proven to improve glycemic control and self-management skills in participants who participated in this program voluntarily.
5.	Zhang et al., 2019	Effectiveness of Smartphone App-Based Interactive Management on Glycemic Control in Chinese Patients with Poorly Controlled Diabetes: Randomized Controlled Trial	To determine the effectiveness of an application-based interactive management model between patients with a history of uncontrolled diabetes and a team of health care professionals.	RCT	Two hundred seventy-six participants with type 1 DM and type 2 DM were randomized into three groups with the same ratio.	Group A received the usual care without using the app. Group B received education through an application called Welling. Group C received education through interactive applications and online management with health workers.	Significant improvement in glucose levels cannot be achieved long-term in patients with uncontrolled diabetes mellitus. Using the app and interactive management together can help maintain glycemic control.
6.	Xu et al., 2020	Improving HbA1c with Glucose Self-	To assess the effectiveness of	RCT	65 diabetic patients were randomized	EpxDiabetes is one of the telemedicine media in the	EpxDiabetes has been shown to

		Monitoring in Diabetic Patients with EpxDiabetes, a Phone Call and Text Message-Based Telemedicine Platform: A Randomized Controlled Trial	EpxDiabetes in lowering FBG and HbA 1c in patients with poor glycemic control and evaluate the impact of social determinants of health.		to a primary care clinic	form of SMS and telephone calls that allow two-way communication between clients and health workers. The intervention group ran this program for six months with an average frequency of sending messages three times per week.	reduce HbA1c levels in patients with uncontrolled type 2 diabetes mellitus.
7.	Or et al., 2020	Improving Self-Care in Patients with Coexisting Type 2 Diabetes and Hypertension by Technological Surrogate Nursing: Randomized Controlled Trial	To test and demonstrate the efficacy and safety of a TSN prototype administered to patients with complex chronic diseases typical of coexisting type 2 diabetes and hypertension.	RCT	299 diabetes and hypertension outpatients at two Hong Kong public hospitals were randomized to either the intervention group (n = 151) or the control group (n = 148).	eHealth Technological Surrogate Nursing running on a tablet computer. The tablet contains a module available to provide text-based and video-based learning resources related to the causes and prevention of type 2 diabetes and hypertension, self-care, exercise, diet, health planning, and stress management. The audio function can be programmed to emit action reminders at preset times.	Statistically significant results that directly indicated the effectiveness of TSN in terms of hemoglobin 1c were found in both groups but were not associated with systolic and diastolic blood pressure.
8.	Sun et al., 2019	Mobile Phone-Based Telemedicine Practice in Older Chinese Patients with Type 2 Diabetes Mellitus: Randomized Controlled Trial	To investigate the benefits of using a mobile phone-based telemedicine application for self-management of elderly patients with a history of type 2 diabetes mellitus	RCT	A total of 91 elderly patients aged over 65 years with a history of type 2 diabetes mellitus were randomized into two groups, namely the intervention group (n=44) and the control group	The mHealth management app uploads the glucometer data. Automatically sent to the medical server (the glucometer is connected to the phone via Bluetooth). All patients were followed up in the outpatient clinic at 3-month intervals.	Mobile telemedicine applications are proven to improve glycemic control in elderly patients with a history of type 2 diabetes mellitus.

					(n=47).		
9.	Amante et al., 2021	Evaluation of a Diabetes Remote Monitoring Program Facilitated by Connected Glucose Meters for Patients with Poorly Controlled Type 2 Diabetes: Randomized Crossover Trial	To evaluate a remote blood glucose monitoring program for diabetic patients using a blood glucose meter automatically connected to a mobile device.	RCT	The 119 patients involved were divided into two groups with the same intervention.	The intervention group carried out blood glucose measurement procedures through an application directly connected to a mobile device and diabetes training via telephone calls. The intervention was given for 12 months with two evaluations, namely in the 6th and 12th months.	In the first six months, there was an improvement in HbA1c and no significant change at month 12. Both groups reported the same increase in satisfaction with the given intervention.