Coping with HIV Stigma among People Living with HIV in Yogyakarta, Indonesia: A Mixed-Methods Approach

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Hurin'in Aisy Baridah[1], I Ketut Sudiana[2], Supriyanto[3]

Abstract

Introduction: Glycemic control in DM is responsive to the condition of patients who have hemoglobin A1c (HbA1c) levels of 5-6%. However, most patients find it difficult to achieve the target of glycemic control. Diabetes Self-Management Education (DSME), which integrates the five pillars of DM management, emphasizes intervention behavior independently. The purpose of this systematic review is to analyze the effectiveness of diabetes self-management education intervention with short message service (SMS) or mobile application on glycemic control.

Methods: This systematic review was conducted by searching five electronic databases, such as *Scopus, PubMed, Science Direct, Springer Link* and *ProQuest* over five years or more with full text in the English language. The search keywords were adjusted according to the medical subject headings and Boolean operators. This study used the PRISMA flow chart to select articles. Fifteen studies were included if they reported on diabetes self-care management education intervention with short message service or mobile application interventions in patients with diabetes. Reviews and editorials were excluded.

Results: DSME interventions with SMS and with mobile application have effectiveness to manage and decrease glycemic control (HbA1c and blood glucose level) by health education, diet monitoring, and self-monitoring of blood glucose levels.

Conclusion: This systematic review has shown that DSME intervention with SMS and mobile application significantly improves glycemic control despite the heterogeneity across the studies. The recommendation for further research is to analyze the comparison of the effectiveness of online and direct DSME intervention, which can improve glycemic control.

Keywords

diabetes; glycemic; mobile application; short message service

INTRODUCTION

Diabetes mellitus is a complex, chronic illness requiring continuous medical care with multifactorial risk-reduction strategies beyond glycemic control (American Diabetes Association, 2020). Medication costs are rising in parallel and threaten to bankrupt national health systems. Despite increased use of

[1] [1] Master of Nursing Faculty Airlangga University
[2] Faculty of Medicine Airlangga University
[3] Nursing Major, Poltekkes Kemenkes Surabaya

Corresponding Author:
Hurin'in Aisy Baridah, Master of Nursing Faculty Airlangga University, Indonesia
Jl. Airlangga No.4 - 6, Airlangga, Kec. Gubeng, Kota SBY, Jawa Timur 60115
Email: hurinin.aisy.baridah-2018@fkp.unair.ac.id

medications and the advent of new pharmacological treatments, glycemic control among those with diabetes does not appear to have improved since 2010 (Berman *et al.*, 2018). According to the latest statistics from the International Diabetes Association, the incidence of diabetes in adults (20–79 years) has risen to 425 million worldwide, and this number is projected to increase to 629 million by 2045. Currently, the largest number of people with diabetes (20–79 years) are in China (114 million), India (73 million), and in the USA (30 million) (IDF, 2017). Almost 87.5% of DM patients have not met the target of glycemic control (PERKENI, 2015). Poor glycemic control has a negative impact on treatment failure which will result in poor health and the emergence of long-term complications such as retinopathy, nephropathy, and neuropathy (Nie *et al.*, 2016).

The impact of DM complications includes increasing economic losses, medical costs, job losses and low quality of life (World Health Organization, 2016). Obstacles in glycemic control are low adherence to self-management regimens in DM (Wang, Cai and Padhye, 2018). In addition, DM patients have difficulty adhering to treatment recommendations and healthy lifestyle modifications. The involvement of individuals, families, healthcare providers, and health system determinants in self-management intervention for DM is needed to reduce complications, morbidity and mortality (Pan *et al.*, 2018). Self-management can be formed with the individual's belief in the ability to control their health conditions, and being able to make the best decisions to improve the quality of life (Yang and Lee, 2020). Self-management is the main foundation in DM control (Cui and Wu, 2016). Self-management is widely used as an intervention for chronic diseases, including DM. The American Diabetes Association (ADA) suggests self-management interventions in DM as a way to encourage patients to achieve appropriate health outcomes that have an impact on improving psychological balance and changing behavior (American Diabetes Association 2018).

Diabetes Self-Management Education (DSME) integrates the five pillars DM management emphasizes intervention behavior independently. Researchers have identified a special skill called self-management that helps change various factors associated with obedience that can ultimately help change lifestyle. DSME uses the guidelines, counseling, and behavioral interventions to increase knowledge regarding diabetes and improve skills in individuals and families in managing DM disease. Health education using the DSME method is not just using direct or indirect counseling methods straight away but grows with encouraging participation and cooperation of diabetics and their families (Laili and Dewi, 2019). DSME may be given in group or individual settings or using technology such as telehealth. Telehealth increases access to healthcare and is associated with increased self-efficacy and self-management in adults with type 2 diabetes. Telehealth has been validated to be a cost-effective alternative to face-to-face visits between provider and patients that improves glycemic control for adults with type 2 diabetes mellitus (National Conference of State Legislatures, 2016). Telehealth is a general term that includes a growing variety of applications and services like two-way video, email, short message service (SMS) and mobile application and other forms of telecommunications technology.

Some studies suggest that DSME intervention is significant in increased glycemic control, psychological balance and lifestyle changes (Islam and Niessen, 2015;Fortmann and Gallo, 2017;Wang *et al.*, 2020). Several studies on DSME interventions have been carried out to determine the effect of the intervention on glycemic control in DM patients. However, until now there has been no comprehensive summary of various types DSME interventions on glycemic control in DM patients. Based on the description above, it is necessary to review the effectiveness of DSME intervention with short message service (SMS) or mobile application and their effect on glycemic control in DM patients.

MATERIALS AND METHODS

Study design and search strategy

The current study is a systematic review design which is a review from eligible full text articles. Comprehensive search was conducted in five electronic databases, including *Scopus, PubMed, Science Direct, Springer Link* and *ProQuest* from June until July 2020 limited to the publications of the last five years from 2015 to 2020 and full text article in English.

Appropriate keywords were defined from Medical Subject Headings (MeSH) using Boolean operator and phrase searching for 'diabetes' AND 'glycemic' AND 'mobile application' AND 'short message service' and related words were obtained with advice of an experienced researcher in the field.

Search strategy

The next step after the articles suitable with the criteria were collected was to analyze and form the articles according to the specified inclusion and exclusion criteria. Inclusion criteria for this systematic review are (1) elderly patients (45-60 years), (2) patients with T2DM in hospital or clinic, (3) patients who are cooperative. Exclusion criteria in this systematic review are (1) patients experiencing complications (stroke, heart, kidney), and (2) patients who have dementia and aphasia. The article search process was carried out from June until July 2020. The article search used keywords determined by the researchers and limited by the inclusion and exclusion criteria. The data obtained were then selected one-by-one by the researchers to determine the suitability of the articles desired by the researchers and to delete duplicate articles or those that did not fit the criteria. After getting the articles appropriate to the research, the articles were analyzed one-by-one and grouped to get the results. The next step is to discuss based on the points obtained from the selection results.

Selection criteria

In the present study, guidelines and protocols concerning pre-hospital pain management, published in journals article or released on valid organizations' websites were included. Reviews being narrative, lack of a report on the complete process of the guideline's extraction, and lack of a report on the systematic review's process were considered as exclusion criteria.

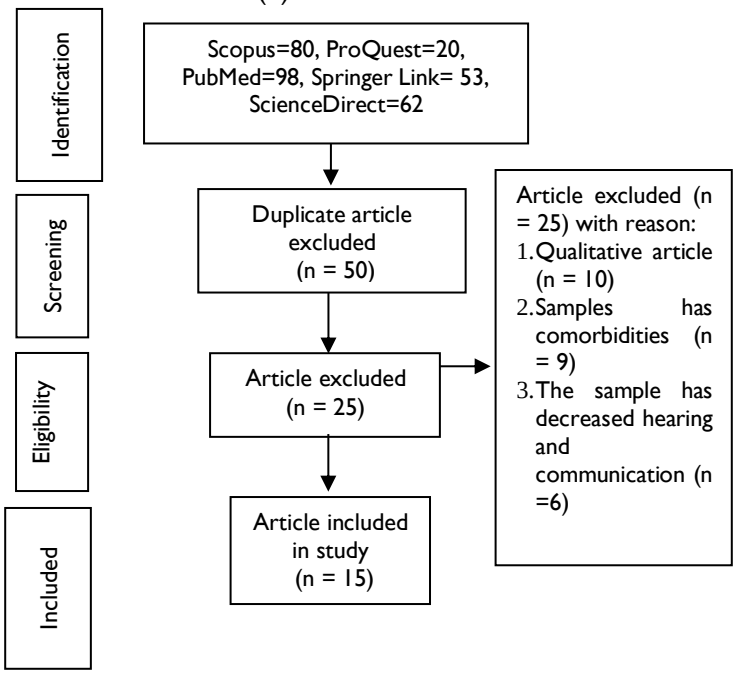


Figure 1. Flow diagram and article selection process

Data collection

The data collected from databases were saved in Mendeley. Two independent researchers studied the records and screened titles, abstracts and full text of relevant guidelines. After review of the full text of these guidelines, data were filed in a PRISMA checklist. Any disagreement was discussed and resolved. Recorded data in the checklist consisted of name of the guideline, year of publication, studied medications and outcomes of study.

Quality assessment of the articles

Quality assessment of the articles was performed using *Joanna Briggs Institute* (JBI)

guideline in order to determine the agreement and fulfilment of the criteria suitable for type of study.

Search outcome

Literature search resulted in 333 articles (100 from Scopus, 20 from ProQuest and 98 from PubMed, 53 from Springer Link and 62 from Science Direct). After reviewing the abstract for relevance and matching to inclusion criteria, 50 articles were selected for full text review. There were 25 full text articles excluded for several reasons, because of the suitability of the sample, the type of research and the health conditions. Articles excluded (n = 25) with reason:

1. Qualitative article (n = 10)
2. Samples has comorbidities (n = 9)
3. The sample has decreased hearing and communication (n =6)

The final selection of 15 articles was chosen for systematic review, as shown in Figure 1.

Main outcomes in the study are analysis and review of full articles about effectiveness diabetes self-care management education (DSME) intervention with short message service (SMS) or mobile application in glycemic control in patients with T2DM.

RESULTS

Fifteen of the resulting articles of the studies were of hospital, university hospital, community health service and clinic., covering a total from lowest number of participants, 50, and highest as many as 502 patients, and the remaining fifteen studies were carried out in Bangladesh, USA, Cambodia, two studies in Turkey, Mongolia, Mexico, three studies in China, Indonesia, Netherlands, Sri Lanka, Iceland, and Japan. Overall, short message service (SMS) or mobile application are the means most commonly used to deliver education about diabetes self-care management education (DSME) in T2DM patients.

From Table 1, fifteen studies met the inclusion criteria of glycemic control, but were highly heterogeneous. Research study analyzes from title, author, design of study, population, place, intervention, result and time. All fifteen studies use Randomized Control Trial (RCT) design.

Table 1. Article selection of effectiveness of diabetes self-care management education (DSME) intervention with short message service (SMS) or mobile application in glycemic control in patients with T2DM

No	Title Author	Study Design	Population, Place	Intervention	Result	Time
1.	Effects of Mobile Phone SMS to Improve Glycemic Control Among Patients With Type 2 Diabetes in Bangladesh: A Prospective, Parallel-Group, Randomized Controlled Trial (Islam and Niessen, 2015)	RCT	200 participants in Bangladesh	Mobile Phone SMS	Least squares means the difference HbA1c from baseline until after 6 months (primary end point) was 20.85 (95% CI21.05,20.64) in the SMS and group 20.18 (20.41, 0.04) in the control group	6 months
2.	The effect of automated text messaging and goal setting on pedometer adherence and physical activity in patients with diabetes: A randomized controlled trial	RCT	138 participants in Iowa Hospital and Clinic USA	Fitbit and automated text messaging	The results showed 17.2 percent more allow the use of the Fitbit Reminder and Fitbit Goal Setting to produce a significant value of 791 daily steps, but it cannot be said that there is a	6 months

	(Polgreen and Anthony, 2018)				definite effect on the daily step.	
3.	The effect of text message support on diabetes self-management in developing countries - a randomised trialcare in diabetic patients: study protocol for a randomized controlled trial (Van Olmen and Kegels, 2017)	RCT	480 participants in Cambodia	SMS text sent 5 times per week in Kin-réseau, 6 times per week in MoPoTsyo, and 2 times per week in FiLDCare.	After two years, the proportion of subjects with controlled HbA1c was 2.8% higher in the intervention group than in the control group.	2 years
4.	The effect of diabetes education and short message service reminders on metabolic control and disease management in patients with type 2 diabetes mellitus (Güner and Coşansu, 2020)	RCT	Zonguldak Turki 101 patients with type 2 diabetes mellitus (>18 years) who were using oral antidiabetics	Diabetes education and short message service reminders	Diabetes education and SMS reminders sent for six months were effective in improving metabolic control and disease management in patients with type 2 diabetes	3-6 months
5.	The Role of Text Messaging Intervention in Inner Mongolia among Patients with Type 2 Diabetes Mellitus: A Randomized Controlled Trial (Wang and Liu, 2020)	RCT	171 Patients with T2DM (> 18 years)	Short messages service (SMS)	Short messages service (SMS) can improve health behavior with proven reduction in fasting blood glucose and postprandial blood glucose.	1 months
6.	Dulce Digital: An mHealth SMS-Based Intervention Improves Glycemic Control in Hispanics With Type 2 Diabetes (Fortmann and Gallo, 2017)	RCT	126 articipants with poorly controlled type 2 diabetes in Mexico	Dulce Digital participants received up to three motivational, educational, and/or call-to-action text messages per day.	Dulce Digital group achieved a significantly greater reduction in HbA1cover time compared with UC (P= 0.03).	6 months
7.	Effects of Mobile Text Messaging on Glycemic Control in Patients With Coronary Heart Disease and Diabetes Mellitus A Randomized Clinical Trial (Huo and Krumholz, 2019)	RCT	502 patients from 34 hospitals in China.	The ntervention group received 6 text messages per week in addition to usual care.	The ntervention group had a greater reduction in HbA1C (−0.2% vs. 0.1%; P=0.003). asting blood glucose was larger in the intervention group (−0.6 mmol/L; 95% CI, −1.1 to −0.2; P=0.011),	6 months
8.	Going Mobile With Diabetes Support: A Randomized Study of a Text Message–	RCT	93 adult patients with poorly controlled type	Patients in both groups continued with their usual care;	There was no statistically significant difference between	6 months

	Based Personalized Behavioral Intervention for Type 2 Diabetes Self-Care (Capozza and Woolsey, 2015)		2 diabetes (A1C >8%)	patients assigned to the intervention arm also received from one to seven diabetes-related text messages per day depending on the choices they made at enrollment.	the intervention and control groups in terms of change in A1C (P >0.05).	
9.	The Effect of Education through Short Message Service (SMS) Messages on Diabetic Patients Adherence (Adikusuma and Qiyaam, 2017)	RCT	50 outpatients with type 2 diabetes mellitus (T2DM)	The intervention group received Short Message Service (SMS) messages of diabetes education	A decrease in the fasting blood glucose in the control group (19.88 45.56) and treatment group (25.6 52.19) and a decrease in blood glucose measured 2 h postprandially in the control group (19.88 55.88) and the treatment group (27.36 80.16) can be seen.	6 months
10.	The Effects of a Mobile Phone Application on Quality of Life in Patients With Type I Diabetes Mellitus: A Randomized Controlled Trial (Drion and Pameijer, 2015)	RCT	63 participants In Netherlands	Patients download the DBEES application on their smartphone. The patient is asked to use the DBEES application. Patient can enter diabetes self-care data: blood glucose values, carbohydrate intake, medications, physical exercise.	Glycemic control, diabetes-related emotional distress (PAID), and the SMBG frequency remains unchanged in both group after 3 months, without a significant difference between groups. Intervention group review DBEES uses.	3 months
11.	The Influence of the Smart Glucose Manager Mobile Application on Diabetes Management (Gunawardena and Jackson, 2019)	RCT	A total of 300 patients in Sri Lanka	Smart Glucose Manager (SGM)	A1c improvement was positively correlated with SGM usage (R =.81, P <.001).	6 months
12.	A Digital Lifestyle Program in Outpatient Treatment of Type 2	Randomized double-blind	37 patients with T2DM (18-75 years) from hospital-based	SidekickHealth smartphone app	Terdapat penurunan yang signifikan dalam HbA1c, tekanan	6 months

	Diabetes: A Randomized Controlled Study (Hilmarsdóttir and Sigurðardóttir, 2020)	controlled trial	endocrine clinic in Iceland	(digital lifestyle program)	dari penyakit dan gejala kecemasan pada kelompok intervensi.	
13.	The effect of education and mobile health management on improvement of blood glucose with type 2 diabetes mellitus (Chai and Wang, 2020)	RCT	Total of 209 patients (91 women, 118 men) with type 2 diabetes mellitus	Mobile Health Management	Compared with baseline, fasting plasma glucose (9.7 mmol/l vs. 6.8 mmol/l,P< 0.001) had decreased significantly. A1c < 7% increased significantly (P<0.001).	4 months
14.	DialBetics With a Multimedia Food Recording Tool, FoodLog: Smartphone-Based Self-Management for Type 2 Diabetes (Waki and Aizawa, 2015)	RCT	A total number of fifty-four patients in Japan	DialBetics application	In the earlier 3-month, diet-evaluation study, HbA1c had declined a significant 0.4% among those who used DialBetics compared with the control group.	3 months
15.	Welltang – A smartphone-based diabetes management application – Improves blood glucose control in Chinese people with diabetes (Zhou and Chen, 2016)	RCT	100 participants	Welltang App	The average decrease in HbA1c was 1.95% (21 mmol/mol) in the intervention group and 0.79% (8 mmol/mol) in patients in the control group (P< 0.001). The average decrease in FBG was 1.89 ± 2.61 mmol/L in patients in the Welltang intervention group .	3 months

From fifteen studies, nine studies discussed about diabetes self-care management education (DSME) intervention with short message service (SMS). Study in Bangladesh was based on the principles of behavioral learning theory sending 90 SMS randomly once a day to participants in the intervention group for more than a -month period. An SMS sending manager website created and SMS delivered in partnership with Grameen phone Bangladesh has a least squares result which means the difference HbA1c from baseline was 20.85 mmol/mol in the intervention group and 20.18 mmol/mol in the control group after six months of interventions (Islam and Niessen, 2015). Furthermore, study from Polgreen (2018) used Fitbit and automated text to assess the effectiveness of automated text messaging and goal setting on pedometer adherence and physical activity in DM patients. This intervention showed 17.2% more followed the use of the Fitbit Reminder and Fitbit Goal Setting to produce a significance value of 791 daily steps to decrease blood glucose level from baseline, but it cannot be said that there is a definite effect on the daily step after six months of intervention (Polgreen and Anthony, 2018).

DISCUSSIONS

Diabetes mellitus (DM) is a heterogeneous metabolic disorder characterized by hyperglycemia due to

abnormalities in insulin secretion, damaged insulin work or both (Punthakee, Goldenberg and Katz, 2018). Hyperglycemia in DM is caused by poor glycemic control (Yang *et al*., 2015). The obstacle in glycemic control is low adherence to the self-management regimen in DM (Bowen *et al*., 2016). This systematic review summarizes 15 articles using DSME interventions with SMS and mobile applications to improve glycemic control.

New study evidence suggests that mobile smartphone applications may be utilized to help deliver health services to patients and can be used as self-management tools (Izahar and Lean, 2017). In this study, we showed diabetes self-management apps, either in iPhone Operating System (iOS) or Android, with the goal of managing self-management diabetes and glycemic control in patients with diabetes mellitus. We found that the mobile apps varied in their features and usability and also had a significant effect to decrease HbA1c and blood glucose in patients with DM. Moreover, mobile-phone/smartphone-based self-management apps appear to have moderate benefits on glycemic control with a pooled effect on HbA1c reduction of -0.50% (-5.47mmol/mol), indicating that the smartphone health app intervention could improve diabetes patients' glycemic conditions. Glycated hemoglobin (HBA1C) is an indicator that reflects the average plasma glucose level over the past two to three 3 months. The HBA1C test is relatively stable and has less variability (Cui and Wu, 2016;Quinn and Butler, 2018).

The Diabetes-Carer application is a mobile phone-based diabetes management platform which can be used by both patients and clinicians. Diabetes-Carer for patients consists of four main parts: diabetic education, self-management, patient community, and real-time communication between patients and clinicians and the resultant HbA1c levels in patients of all groups decreased significantly from baseline. There were significant differences in the proportions of patients that achieved HbA1c<7% between groups, especially in intervention group for six months duration of study in Shanghai (Yu and Yan, 2019). Welltang is a smartphone-based diabetes management application, which can be used by both patients and clinicians. Welltang for clinicians is associated with patients' data. Welltang for patients consists of three main parts: knowledge, self-management, and communication between patients and clinicians and the result showed the average decrease in HbA1c was 1.95% (21 mmol/mol) in the intervention group and 0.79% (8 mmol/mol) in the control group (P< 0.001) after three months of study in China (Zhou and Chen, 2016).

Diabetes Self-Management Education (DSME) is an effort that nurses can make to provide continuous education for DM patients. DSME has the advantage of integrating the five pillars of DM management using guidelines, counseling and behavioral intervention methods. This method is expected to increase knowledge about diabetes and individual skills in managing DM (Chrvala, 2016). The DSME method is not only carried out by direct health education, but also indirectly where DM patients are involved in its management. The application of DSME using technology in the form of SMS, web, and Android applications has been proven effective in reducing HbA1c and improving independent patient self-management (Boels *et al*., 2018; Kotsani *et al*., 2018;Rasoul *et al*., 2019). DSME interventions with SMS and mobile applications can help DM patients achieve glycemic targets and can be cost-effective in healthcare. In the current era, telephone-based / online interventions allow it to be easily used in the community. These technological developments can be included as a companion intervention in the care of DM patients in improving glycemic control. Both studies show the importance of mobile application features that include interaction and communication between clinicians or health workers and patients.

The results obtained from this review have limitations. Only a few articles were collected according to the inclusion criteria and research comparing interventions is not widely used, making it difficult to determine which intervention is more effective.

CONCLUSION

Diabetes Self-Management Education (DSME) intervention delivered by with smartphone health applications as a media short message service (SMS) and mobile phone-based application may help to manage to decrease glycemic control (HbA1c and

blood glucose level) in patients with diabetes in long=term management. Diabetes Self-Management Education (DSME) intervention with SMS and mobile application can be launched into clinical practice and is helpful for health workers. The recommendation for further research is to analyze the comparison of the effectiveness of online and direct DSME intervention, which can improve glycemic control.

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Conflict of Interest

None.

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