

Review Article

Influence of the Model of Care on the Outcomes of Diabetes Self-Management Education Program: A Scoping Review

Emmanuel Kumah ¹, Emmanuel K. Afriyie,² Aaron A. Abuosi,³ Samuel E. Ankomah ⁴, Adam Fusheini,^{4,5} and Godfred Otchere¹

¹Policy, Planning, Monitoring, & Evaluation Unit, Komfo Anokye Teaching Hospital, Kumasi, Ghana

²Laboratory Services Directorate, Komfo Anokye Teaching Hospital, Kumasi, Ghana

³Department of Public Administration and Health Services Management, University of Ghana Business School, Ghana

⁴Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, Dunedin, New Zealand

⁵Center for Health Literacy and Rural Health Promotion, P.O. Box GP1563, Accra, Ghana

Correspondence should be addressed to Emmanuel Kumah; ababiohemmanuel@gmail.com

Received 15 May 2020; Revised 14 January 2021; Accepted 11 February 2021; Published 20 February 2021

Academic Editor: Ryan T. Crews

Copyright © 2021 Emmanuel Kumah et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Background. Type 2 diabetes mellitus (T2DM) accounts for approximately 95% of all diabetes cases, making the disease a global public health concern. The increasing prevalence of T2DM has highlighted the importance of evidence-based guidelines for effective prevention, management, and treatment. Diabetes self-management education (DSME) can produce positive effects on patient behaviors and health status. **Study objective.** We synthesized findings from the existing studies to find out whether or not the impact of DSME on patient health behaviors and outcomes differ by the different models of diabetes care. That is, we determined whether there are differences in DSME outcomes when patient's care provider is a general practitioner, a specialist, a nurse, or a combination of these health professionals. **Methods.** Searches were made of six electronic databases to identify relevant English language publications on DSME from 2000 through 2019. Titles and abstracts of the search results were screened to select eligible papers for full-text screening. All eligible papers were retrieved, and full-text screening was done by three independent reviewers to select studies for inclusion in the final analysis. Twenty-one studies were included in the final analysis. The main outcome measures assessed were glycated hemoglobin (HbA1c), body mass index (BMI), diet, and physical activity. **Results.** The majority of the patients with diabetes were seen by primary care physicians. In general, the studies reported significant improvements in patient health behaviors and outcomes. Some differences in outcomes between the different models of care were observed. **Conclusion.** Our findings suggest that the effects of DSME on patients' health behaviors and outcomes could differ by the different models of diabetes care. However, considering the limited sample of publications reviewed, and because none of the reviewed studies directly measured the impact of the DSME program on patient behaviors and outcomes, significant conclusions could not be reached.

1. Introduction

Diabetes mellitus (DM) is one of the most common chronic disorders in the world [1]. It is the fifth leading cause of mortality in most high-income countries and rapidly becoming a major health concern in low- and middle-income countries [2]. The global diabetes prevalence in 2019 was estimated at 9.3% (463 million people), and this is estimated to rise to 10.2% (578 million) by 2030 and 10.9% (700 million) by

2045 [3]. There are three main types of diabetes: type 1 diabetes (caused by the body's failure to produce insulin), type 2 diabetes (resulting from insulin resistance), and gestational diabetes (which occurs in pregnant women without previous diagnosis of diabetes) [4]. Type 2 diabetes is the most common type, accounting for approximately 95% of all cases of diabetes [5].

The cost of diabetes care is expensive, and the condition can lead to serious complications such as kidney failure,

myocardial infarction, stroke, blindness, and limb amputation [6]. It imposes a huge economic burden on national health care systems globally [1]. That notwithstanding, evidence indicates that early diagnosis and effective management increases the chances of preventing harmful and costly complications associated with diabetes [7]. Evidence has also been established regarding the benefits associated with glycemic control in reducing the risk for and delaying the progression of diabetes complications [8]. Achieving effective glycemic control requires a lifelong adherence to complex lifestyle management, involving regular blood glucose monitoring, self-adjustment of medications, and a physically active lifestyle.

Self-management education (SME) is recognized globally as a tool that helps patients achieve optimum glucose control, through increasing knowledge and awareness, and learning behavioral strategies to manage diabetes [1]. SME is defined as a systematic intervention involving active patient participation in self-monitoring and/or decision-making [9]. Diabetes self-management education (DSME) provides patients with the requisite knowledge and skills to perform self-care behaviors, manage crises, and make lifestyle changes [10]. The program involves different educational, psychological and behavioral interventions; and a combination of didactic, interactive, and collaborative teaching methods tailored to patient's specific needs. Education sessions range from brief instructions by lay leaders, physicians, dietitians, or nurses to more formal and comprehensive programs [7]. Self-efficacy [11], which refers to one's belief in his or her ability to adopt a particular behavior, is a vital component of the concept of SME.

SME is often considered an aspect of patient education. However, the two activities can be distinguished from one another. Patient education focuses on delivering knowledge and skills to patients to enable them to follow medical advice. SME, on the other hand, is concerned with empowering patients to take active control of their illness and apply problem-solving skills to meet new challenges [12].

Many empirical studies [13–18] have demonstrated that DSME programs have a beneficial effect on patients' health status, health behavior, and healthcare utilization, which subsequently reduces the total cost of treating patients with diabetes. In addition, several systematic reviews have shown improvements in outcomes such as better glycemic control, increased weight loss, increased knowledge, decreased blood pressure, improved dietary and exercise habits, and decreased need for diabetes medication [19, 20].

The effectiveness of the DSME program depends on human factors [21, 22], organizational processes [8], and intervention attributes [23, 24]. One other key factor to the success of DSME programs is the influence of patient's routine clinical care provider [8]. Care providers' role—such as serving as conduits for patients to enter the programs, guiding them through the process, and reinforcing what is learned during regular follow-up care—is equally critical to successfully implementing these initiatives [18, 25]. Different health care professionals are responsible for providing care to diabetes patients [26]. However, evidence of whether or not there are differences in DSME outcomes when participant's

care provider is a general practitioner, a specialist, a nurse, or a combination of these health professionals has not yet been systematically established.

With this paper, we synthesized findings from the existing literature to determine whether or not the effects of DSME on patients' health behaviors and outcomes differ by the different models of diabetes care. We defined “model of diabetes care” in this study as the type of health professional providing clinical care to patients with diabetes. We focused the review on studies dealing with type 2 DM.

2. Models of Routine Diabetes Care

Different models of diabetes care exist in different healthcare settings. One of such models is the specialist service delivery model, involving the use of diabetologists or endocrinologists as providers of diabetes care [27]. The most common model is the primary care physician-led model, where patients with diabetes are managed by primary care physicians [28]. There is also the nurse- and dietitian-led model in which nurses and dietitians, under the supervision of specialists, follow algorithms to deliver education and medical care to patients with diabetes [29]. Other models of diabetes care include advanced nurses and physician-led model [28], nurses and pharmacist-led model [30, 31], clinical pharmacist-led model [32–34], and nurse-led model [35, 36].

Due to the complex nature of diabetes, recent literature emphasizes the application of a team approach to the delivery of care [37–40]. This model of care enables a range of health care providers (primary care physicians, diabetologists, registered nurses, nurse practitioners, physician assistants, certified diabetes educators, dietitians, and pharmacists) to integrate their skills to facilitate improved patient management and outcomes.

3. Methods

We used a systematic scoping review, guided by the three-step search strategy recommended by the Joanna Briggs Institute [41] and the PRISMA statement for systematic reviews protocols [42], to gather and summarize the existing literature on the possible influence of the model of diabetes care on the outcomes of DSME interventions. As Arksey and O'Malley have stated that quality assessment does not form part of a scoping review [43], our study does not include assessment of methodological quality of the included papers.

3.1. Search Strategy. The search strategy for this review was first drafted for pretesting in (OVID) MEDLINE. Once the MEDLINE strategy was pretested and finalized, it was adapted to the syntax and subject headings of all the other databases searched in the study. Table 1 demonstrates the search strategy and keywords used (“diabetes mellitus” and “diabetes self-management education”).

The search was conducted between December, 2019 and January, 2020. The following databases and search engines were searched: PubMed, Scopus, MEDLINE, EMBASE, PsychINFO, and the Cochrane Central Register of Controlled Trials. In addition, reference lists of all eligible articles

TABLE 1: Detailed search strategy for the scoping review of Diabetes SME interventions.

Search	String
1.	Type 2 diabetes mellitus.mp. or exp noninsulin-dependent diabetes mellitus
2.	Diabetes mellitus.mp. or exp diabetes mellitus/
3.	#1 OR #2
4.	Diabetes self-management.mp.
5.	Diabetes self-management education.mp. or exp diabetes self-management education/or exp patient self-management education/or exp self-care/
6.	Self-management program.mp. or exp self-management intervention/
7.	#4 OR #5 OR #6
8.	#3 AND #7

identified were searched and screened for additional relevant studies. We restricted the search to only English language medical literature published between January, 2000 and December, 2019.

3.2. Inclusion and Exclusion Criteria. The inclusion criteria are as follows:

- (i) The primary focus of the study should be on self-management education for type 2DM
- (ii) The study evaluated the effectiveness of the DSME program on at least one of the following outcome measures: glycated hemoglobin (HbA1c), body mass index (BMI), diet, self-efficacy, mental health, and health service utilization
- (iii) The study specified the type of health professional providing routine clinical care to diabetes patients
- (iv) The paper was written in the English language

The exclusion criteria are as follows:

- (i) The study is a review article or a report
- (ii) The study was not peer-reviewed
- (iii) The focus of the paper was on type 1 or both type 1 and type 2 diabetes patients
- (iv) Participants of the study were type 2 diabetes patients and patients with other chronic conditions such as hypertension and asthma
- (v) The leader of the DSME intervention was at the same time patients' routine clinical care provider

3.3. Study Selection Process. Selection and inclusion of papers for this review involved a two-stage process: screening of abstracts and titles and full-text reading to select eligible papers for final inclusion. Three independent reviewers (EK, EKA, and SEA) conducted the selection process through each stage of the review. All publications retrieved through the search were imported into a shared bibliography for duplicate records to be removed. After removing the duplicates, the reviewers applied the predetermined inclusion and exclusion criteria and independently assessed the titles

and abstracts for full-text review eligibility. Following this process, articles were selected for full-text screening. Again, the reviewers applied the inclusion and exclusion criteria and independently assessed the full-text articles to select the final set of publications eligible for inclusion in the study. After each stage of the selection process, the reviewers compared results and reached a consensus, with a fourth reviewer (AF) serving as a tiebreaker in an event that the three reviewers failed to reach an agreement.

3.4. Data Extraction. Data from the eligible papers were extracted by three members (EK, AAA, and GO) of the research team working independently and checked by a fourth member (AF) to ensure consistency and accuracy of the extracted information. The abstractors documented information on authors and year of publication, sample size, study site (country), study design (randomized controlled trial, quasiexperiment, etc.), intervention type (individual, group, etc.), length of program, program leader (dietitian, nurse, peer educator, physician, etc.), setting of diabetes care (clinic, general medical practice, hospital, etc.), diabetes care provider (general practitioner, specialist, etc.), and study outcomes. We extracted data on the effects of diabetes self-management interventions on glycated hemoglobin (HbA1c), body mass index (BMI), diet, physical activity (aerobic or stretching/strengthening exercise), self-efficacy, mental health (psychological well-being, depression, anxiety, and health distress), and health service utilization (emergency room visits, physician visits, hospital admissions, and length of stay).

4. Results

4.1. Literature Search. The search identified a total of 1,267 papers: 1,261 from the electronic database search and six from the manual search. Following the removal of duplicates, 1,100 articles remained. The abstracts and titles screening resulted in the exclusion of 668 articles, leaving 432 for full-text screening. Four hundred and eleven (411) articles were further excluded after the full-text reading. The most common reason for exclusion was lack of outcome assessment of program effectiveness ($n = 153$). Other common exclusions included article not specifying the name of diabetes care provider ($n = 41$), focusing on either type 1 ($n = 25$), or both

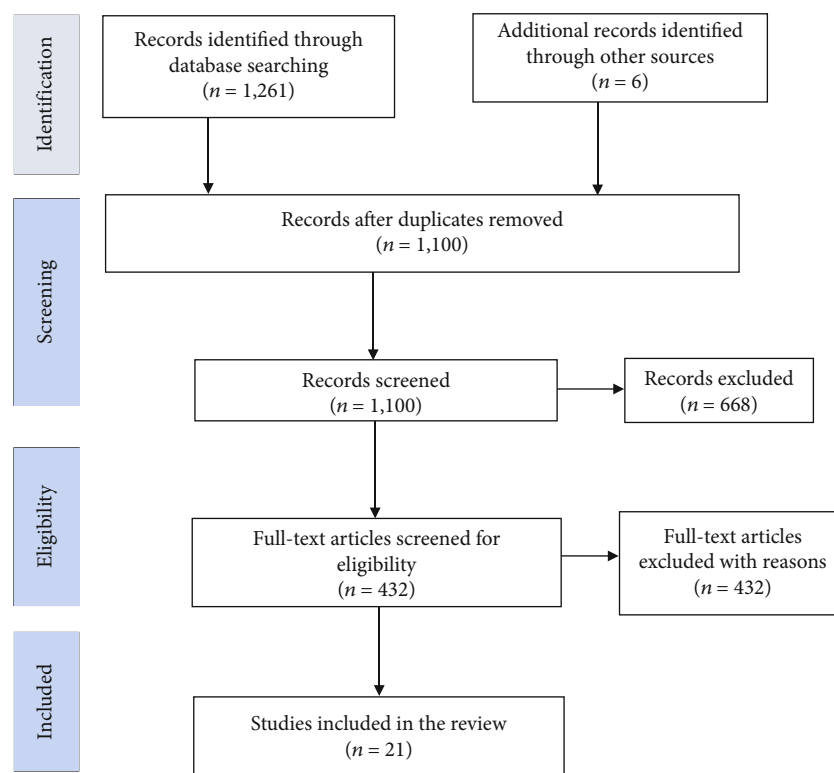


FIGURE 1: Literature search flow diagram.

type 1 and type 2 ($n = 97$) diabetes, focusing on health professionals and diabetes educators ($n = 28$) and focusing on more than one chronic disease ($n = 30$). In all, 21 articles were included in the final analysis. The flow diagram in Figure 1 depicts stages of study identification and selection.

4.2. Description of Studies. Detailed description of the selected studies is presented in Table 2. A total of 4,943 patients with type 2 diabetes were included in the 21 studies. The majority of the studies were conducted in the US (48.9%), randomized controlled trials (57%), group focused (57%), and were professionally led educational programs (76.2%). Most of the studies (15) did not specify the name of the intervention evaluated. The common ones mentioned were the X-PERT and the DESMOND Programs. Detailed information on the interventions evaluated by the included studies is presented in Table 3. Duration of the interventions varied, with the shortest being 6 hours long, delivered between one and two days, and the longest lasting over 2.5 years.

4.3. Outcomes. Table 4 displays the setting of care, name of care provider, and the outcomes of interest of the 21 studies. The majority of the interventions (52.4%) were delivered in primary care practice settings, followed by community health facilities (19%) and hospitals (14.3%). Over 60% of the studies (14) included participants receiving care from primary care providers. Three studies mentioned primary care practitioners and nurses as patients' care providers; three indicated specialists as patients' care providers, while one mentioned

primary care practitioners and specialists as providers of patients' routine clinical care.

HbA1c: twenty studies reported on patients' HbA1c levels; nineteen [44–62] showed statistically significant reductions (-), and one [63] reported no significant improvement (=).

BMI: ten studies reported on BMI outcomes; five [44, 46, 58–60] indicated statistically significant positive effects (-), and five [45, 48–50, 61] showed no significant effects (=).

Diet: dietary outcomes were reported in five studies; four [48, 56, 57, 62] had positive effects (+), and one [60] indicated no effect (=).

Physical activity: this outcome was reported in nine studies; six [46, 48, 57–60] had positive effects (+), and three [56, 62, 63] had no significant effects (=).

Self-efficacy: four studies reported on self-efficacy; three [45, 48, 51] indicated positive effects (+), and one [60] showed no significant effect (=).

Mental health: mental health was mentioned in four studies; all [56–58, 63] indicating positive outcomes (+).

Health service utilization: the only study [64] that reported on health service utilization indicated no significant reduction in health services use (=).

Figure 2 shows the total number of studies that reported on each of the outcome measures, together with the number of positive effects indicated on each outcome.

4.4. Model of Care and SME Outcomes. Based on the setting of care and type of care provider, we identified four models of diabetes care: primary care physician-led model, primary care physician and nurse-led model, primary care physician

TABLE 2: Characteristics of selected studies.

Study	Country of study	Sample size	Design	Program name	Type of intervention	Program leader	Program duration
Merakou et al. [44]	Greece	193	CCT	N/A	G	Trained health visitors	4 months
Kazawa et al. [45]	Japan	62	Non-RCT	N/A	I	Nurses	12 months
Dyson et al. [46]	UK	39	RCT	Video education	O	Nurses	6 months
Brunisholz et al. [47]	US	1,920	Retrospective case control	N/A	G and I	Nurses and dietitians	12 months
Kazawa & Moriyama [48]	Japan	30	Pre- and posttest design	N/A	I and O	Nurses	6 months
Gagliardino et al. [49]	Argentina	198	RCT	N/A	G	Peer educators	4 weeks
Rygg et al. [50]	Norway	146	RCT	N/A	G	Nurses	2 to 4 weeks
Yeung et al. [64]	US	60	Single cohort time-series design	Lifelong management	G	Diabetes educator and clinical psychologist	2.5 years
Davies et al. [63]	UK	824	RCT	DESMOND	G	Trained healthcare professional educators	1 day or 2 half days
Pena-Purcell et al. [51]	US	139	Quasiexperimental	N/A	G	Nurses and dieticians	5 weeks
Huang et al. [52]	Korea	154	RCT	N/A	I	Nurses and dietitians	1 year
Song et al. [53]	Korea	31	Quasiexperimental	N/A	G and I	Nurse, dietician, and a physician	10 months
Banister et al. [54]	US	54		N/A	G	Diabetes educators and dietitian	1 year
Goudswaard et al. [55]	Netherlands	54	RCT	N/A	G	Nurses	6 months
Samuel-Hodge et al. [56]	US	117	RCT	A new DAWN	G, I, and O	Peer educators	8-month
Glasgow et al. [57]	US	320	RCT	Diabetes network SME	O	Online professional coach	
Rickheim et al. [58]	US	170	RCT	N/A	G and I	Educators	6 months
Deakin et al. [59]	UK	157	RCT	X-PERT	G	Dieticians	6 weeks
Vincent [60]	US	20	RCT	N/A	G	Diabetes educators and dietitian	8 weeks
Scain et al. [61]	Brazil	104	RCT	N/A	G	Nurses	4 weeks
Two Feathers [62]	US	151	Non-RCT	N/A	G	Trained family health advocates	4 weeks

CCT: clinically controlled trial; RCT: randomized controlled trial; G: group; I: individual; O: other method, e.g., telephone, mail, online, and video.

and specialist-led model, and specialist-led model (Figure 3). Studies that did not mention the specific name of the care provider (e.g., primary care provider) were not included in the models of care classification. Some of the selected studies did not report on all of the outcomes of interest; so, our comparisons were based on four outcome measures: HbA1c, BMI, diet, and physical activity.

Positive effects on HbA1c were reported in both the primary care physician-led model [44, 47–49, 51, 52, 54, 56–59, 64] and the primary care physician and specialist-led model [62] participants' studies, but no statistically significant effects were observed in the specialist-led model [45,

53, 61] and the primary care physician and nurse-led model [46, 55, 60] patients' studies. For instance, in the study by Banister et al. [54] where patients were receiving care under the primary care physician-led model, a significant reduction in mean HbA1c from 9.7 ± 2.4 to 8.2 ± 2.0 was reported. Also, one study under the physician and specialist-led model [62] reported significant reductions in mean HbA1c levels from 8.4 ± 2.3 to 7.6 ± 1.9 . Similarly, positive effects on BMI were reported in the primary care physician and nurse-led model participants' studies [46, 55, 60], but no significant effects were shown in both the specialist-led model [45, 53, 61] and the primary care physician-led model [44,

TABLE 3: Description of the interventions examined.

Study	Intervention
Merakou et al. [44]	6-hour educational program; two hours per week, and spread in three sessions over a period of 3 weeks
Kazawa et al. [45]	12 months educational program incorporating behavior modification theories such as the transtheoretical model, motivation interviewing, and social support theory
Dyson et al. [46]	Video education—the patients watched three lifestyle videos in their own time
Brunisholz et al. [47]	12 months educational program involving instructions in self-monitoring of glucose levels, diet/exercise education, medication management, motivation for self-management, diabetes related problem solving, and lifestyle changes
Kazawa & Moriyama [48]	Self-management skills acquisition program on predialysis patients with diabetic nephropathy
Gagliardino et al. [49]	4-week structured education delivered by previously trained peers
Rygg et al. [50]	15-hour educational program, spread over three sessions, focusing on information about type 2 diabetes and its complications, diet, physical activity, and improving metabolic control
Yeung et al. [64]	2.5-year empowerment-based intervention involving 6 months low intensity and 24 months high-intensity education and support; the high-intensity education consisted of weekly group-based 75-minute support sessions
Davies et al. [63]	6-hour group education delivered in either one day or two half days equivalents
Pena-Purcell et al. [51]	2-hour 5 weekly sessions focusing on experiential and group activities to reinforce lesson concepts
Huang et al. [52]	Ongoing educational intervention with instructions on self-monitoring of glucose, medications, exercise, hygiene (foot care), and complication management
Song et al. [53]	6-week web-based intervention comprising an introduction, understanding diabetes, dietary management, exercise management, drug and test management, stress management, and foot care
Banister et al. [54]	4 hours of education followed by individual dietitian consults and monthly support meetings
Goudswaard et al. [55]	6-month 3-6 weekly sessions focusing on general information on diabetes, reinforcing compliance with actual medication, importance of physical exercise and losing body weight, and nutritional advice
Samuel-Hodge et al. [56]	12 months education: 8 months intensive phase consisting of 1 individual counselling visit, 12 group sessions, monthly phone contacts and 3 encouragement postcards, and 4 months reinforcement phase including telephone contacts
Glasgow et al. [57]	Internet-based educational program incorporating tailored self-management training and peer support
Rickheim et al. [58]	6 months education in 4 sequential sessions delivered at consistent time intervals
Deakin et al. [59]	The X-PERT program involving 6 weekly sessions, each lasting 2 hours long
Vincent [60]	8-week intervention consisting of 8-weekly 2-hour group sessions (including didactic content), cooking demonstrations, and group support sessions
Scain et al. [61]	8-hour structured group education program delivered in 4 sessions for 4 weeks, by a trained nurse educator
Two Feathers [62]	Racial and Ethnic Approaches to Community Health (REACH) Detroit partnership diabetes lifestyle intervention focusing on improving dietary, physical activity, and diabetes self-care behaviors

47–49, 51, 52, 54, 56–59, 64] patients' studies. Again, the primary care physician-led model [44, 47–49, 51, 52, 54, 56–59, 64] and the primary care physician and specialist-led model [62] patients' studies reported positive effects on dietary behaviors, while the primary care physician and nurse-led model participants' studies [46, 55, 60] showed no significant improvements in patients' dietary behaviors. Finally, SME interventions where patients were receiving care under the primary care physician and nurse-led model [46, 55, 60] were more effective on physical activity levels than did interventions where participants' care providers were primary care physicians and specialists combined (primary care physician and specialist-led model) (64). Figure 4 depicts the comparison of the SME outcomes by the models of care.

5. Discussion

Diabetes is a complex, chronic condition that requires both high quality clinical care and effective self-management. Dif-

ferent healthcare professionals are responsible for providing clinical care to patients with type 2 diabetes, but the literature is imprecise on whether there are differences in DSME outcomes when the care provider is a GP, a specialist, a nurse, a pharmacist, or a dietitian. We, therefore, synthesized information from the existing literature to ascertain whether DSME programs implemented in patient populations with different care models produce different outcomes.

Generally, the outcomes reported by the studies showed positive effects. Twenty out of the 21 studies reported positive effects on at least one of the outcome measures selected for this study. No study reported that patients' health status deteriorated after participating in the SME programs. Few studies indicated no statistically significant effect on some of the outcome measures. Our findings thus support the literature that DSME programs produce beneficial effects on patients' health behaviors and outcomes [19, 20].

We observed some differences in outcomes between the different models of care. One factor that could explain these

TABLE 4: Outcomes of DSME programs by type of care provider and setting of care.

Study	Setting of care	Care provider	Outcomes of SME
Merakou et al. [44]	Primary health clinic (diabetic outpatient clinic)	Primary physician	HbA1c (-), BMI (-)
Kazawa et al. [45]	Hospital	Specialist	HbA1c (=), BMI (=), self-efficacy (+)
Dyson et al. [46]	General practice surgeries	Primary care physician and practice nurse	HbA1C (-), BMI (-), physical activity (+)
Brunisholz et al. [47]	Primary care practice	General practitioner	HbA1c (-)
Kazawa and Moriyama [48]	Hospital and clinic	Primary physician	HbA1c (-), BMI (=), self-efficacy (+), diet (+), physical activity (+)
Gagliardino et al. [49]	Primary care institution	Primary physician	HbA1c (-), BMI (=)
Rygg et al. [50]	Primary care practice	Primary care provider	HbA1c (=), BMI (=)
Yeung et al. [64]	General medical practice	Primary physician	Health service utilization (=)
Davies et al. [63]	Primary care practices	Primary care provider	HbA1c (=), mental health (+), physical activity (=)
Pena-Purcell et al. [51]	Community health centre	Primary physician	HbA1c (-), self-efficacy (+)
Huang et al. [52]	Primary care clinic	Primary physician	HbA1c (-)
Song et al. [53]	Hospital	Specialist	HbA1c (-)
Banister et al. [54]	Community clinic	Clinic physician	HbA1c (-)
Goudswaard et al. [55]	General practice	Diabetes nurse and general practitioner	HbA1c (-)
Samuel-Hodge et al. [56]	Community health centre	Primary care clinician	HbA1c (-), diet (+), physical activity (=), mental health (+)
Glasgow et al. [57]	Primary care practices	Primary care physicians	Diet (+), physical activity (+), HbA1C (-) mental health (+)
Rickheim et al. [58]	General medical practice	General practitioner	HbA1c (-), physical activity (+), BMI (-), mental health (+)
Deakin et al. [59]	General medical practice	Primary care physician	HbA1c (-), BMI (-), physical activity (+)
Vincent [60]	Community health centre	Physician and nurse practitioner	Self-efficacy (=), physical activity (+), diet (=), HbA1C (=), BMI (-)
Scain et al. [61]	University hospital	Specialist	HbA1c (-), BMI (=)
Two Feathers [62]	Hospital and community health centre	Primary care physician and specialist	Diet (+), physical activity (=), HbA1c (-)

HbA1c: glycated hemoglobin; BMI: body mass index; (+): increase; (-): decrease; (=): no significant change.

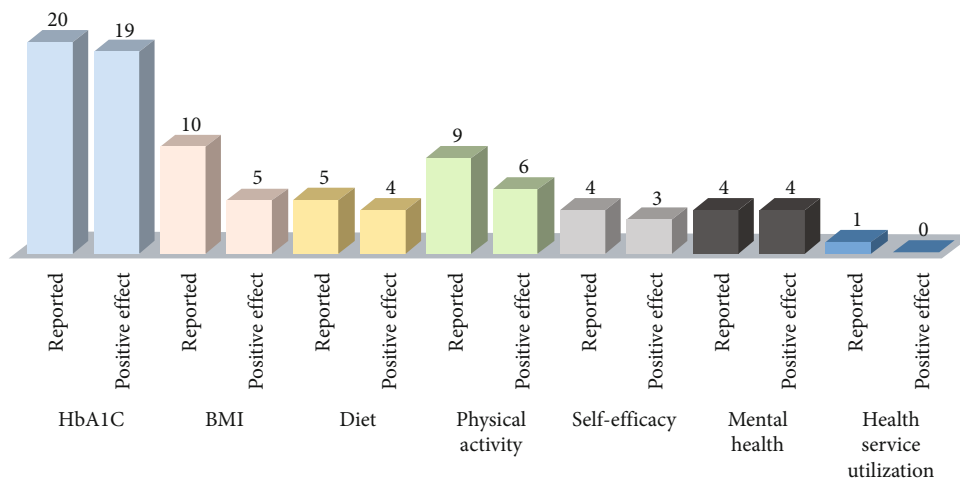


FIGURE 2: Number of studies reporting on the selected outcome measures and the corresponding number of positive effects on each outcome.

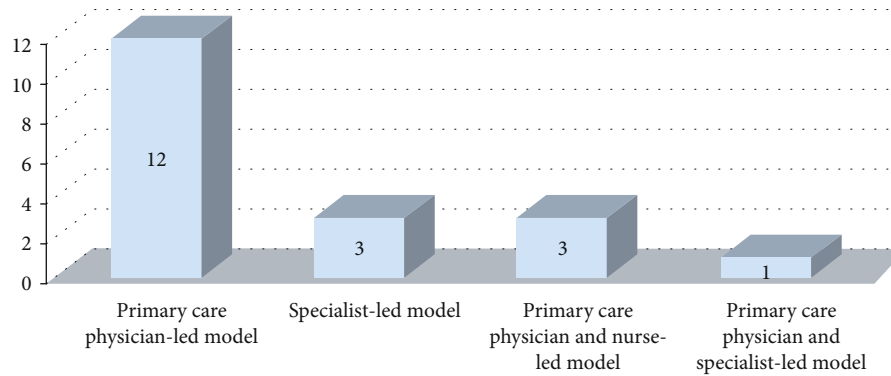


FIGURE 3: Models of diabetes care.

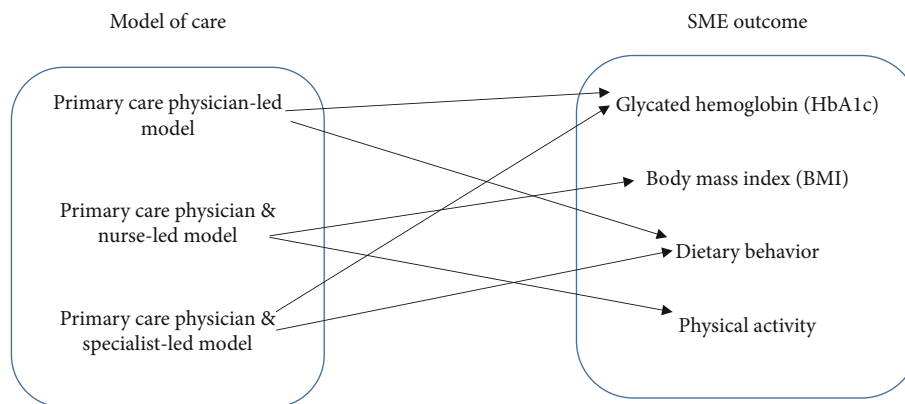


FIGURE 4: Comparison of positive SME outcomes by the different models of diabetes care. The arrow (\rightarrow) indicates the positive effect of a model of care on the SME outcome measures. The specialist-led model has been excluded because it had no positive effect on the outcome measures.

differences is the level of participatory decision-making that might have existed between the study participants and their care providers. A participatory relationship between care providers and diabetic patients promotes healthy behaviors [65]. Thus, the studies in which the participants' care providers allowed them to participate fully in treatment decisions might have contributed to their improved health behaviors and outcomes. Even though the selected studies did not provide information on collaboration between patients and their care providers, available evidence in the literature supports our assertion. For instance, Golin et al. [66] found that patients' participation in decision-making increased their self-efficacy levels. Roter [67] noted that self-management improved when the opinions and values of patients were considered in making treatment decisions. Schillinger et al. [26] observed that patients whose care providers asked them to restate the providers' instructions had lower HbA1c levels than patients who were not given the opportunity to restate what they were told. In a study of 752 diabetic patients, effective patient-provider communication was associated with healthier self-reported behaviors such as physical activity, foot care, and dietary adherence [68].

Another factor that might account for these differences could be the degree of collaboration that existed between the care providers and the DSME instructors. SME programs

that foster effective collaboration between patients' care providers and self-management instructors report better outcomes [69]. For instance, positive effects were reported on all of the outcome measures (diet, physical activity, HbA1c, and mental health) in one of the selected studies [57], where the authors indicated that patients' care providers received quarterly reports from self-management instructors. A study by Garber et al. [70] also found that effective collaboration between care providers and self-management instructors resulted in overcoming barriers to improving HbA1c levels. Available evidence indicates that the most effective SME programs are those that are well integrated into the health system [71]. This is because SME programs that are integrated into patients' usual care appear to foster better and more effective collaboration between self-management instructors and patients' care providers than do programs that are organized separately from the health system [72]. Thus, the role of health professionals is critical to the success of SME initiatives.

We observed that the majority of the studies (90.5%) included in this review were conducted in high-income countries (HICs). Only two [49, 61] were conducted in low- and middle-income countries (LMICs), and none was conducted in sub-Saharan Africa. This therefore calls for more studies on SME programs in LMICs, especially countries in sub-Saharan Africa.

6. Study Limitations

Although only studies published in peer-reviewed journals were considered, the limitations of this review are worth acknowledging. A first limitation relates to the rigorous inclusion and exclusion criteria we adopted. For instance, restricting the search strategy to only English language publications may have resulted in relevant information in studies published in other languages being excluded from our analysis. A second limitation pertains to the limited information on the level of collaboration that existed between patients' care providers and self-management educators. This did not allow us to do a comprehensive analysis of the impact of care providers' involvement in SME interventions on programs' outcomes. Further, the inclusion of studies with different research designs (e.g., randomized controlled trial, quasiexperimental, retrospective case control, and single cohort time-series design) could have implications for the findings synthesized from these studies. The final and the most important limitation relates to the limited sample of publications reviewed. For instance, only three studies each were classified under the specialist-led and the primary care physician and nurse-led models. Also, only one study was found under the primary care physician and specialist-led model. This limits the comparison we made across the different models of diabetes care. Thus, significant conclusions could not be reached. That is, the conclusions drawn are suggestive rather than being conclusive. These limitations notwithstanding, our study provides an important starting point for further investigations into the possible influence of the model of care on the outcomes of DSME programs.

7. Conclusions

The differences we observed suggest that the effects of diabetes SME on patients' health behaviors and outcomes could differ by the different models of diabetes care. This therefore underscores the need to take into consideration patients' routine clinical care providers during the design and implementation of DSME interventions. It is also important for researchers, evaluating the effectiveness of SME interventions, to take into account the possible influence of care providers on program effects. However, because none of the studies reviewed directly measured the association between the model of care and the impact of DSME programs on patient behaviors and outcomes, the conclusion drawn should be interpreted with caution. Future studies should consider testing this association. As no standardized and recognized universal patient education considered effective for all individuals has been defined, and countries are finding ways of providing more cost effective SME interventions, findings from this review offer valuable information to healthcare managers, clinicians, and policy makers. The present study adds to and extends the existing knowledge on factors influencing the effectiveness of DSME programs. It also contributes to the optimal design, implementation, and evaluation of effective self-management interventions.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Authors' Contributions

EK contributed to the conception and study design. EK, EKA, AAA, SEA, AF, and GO contributed to the drafting of manuscript and revising for intellectual content. AF, AAA, and SEA contributed to the review of manuscript. All authors read and approved the final version to be published.

References

- [1] X. Debussche, O. Rollot, C. Le Pormmelet et al., "Suivi ambulatoire individuel et trimestriel apres education initiale hospitaliere dans le diabete de type 2 : l'etude randomisee REDIA-prev2 a la Reunion," *Diabetes & Metabolism*, vol. 38, no. 1, pp. 46–53, 2012.
- [2] J. P. Tripathy, "Burden and risk factors of diabetes and hyperglycemia in India: findings from the global burden of disease study 2016," *Diabetes, metabolic syndrome and obesity: targets and therapy*, vol. Volume 11, pp. 381–387, 2018.
- [3] P. Saeedi, I. Petersohn, P. Salpea et al., "Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition," *Diabetes Research and Clinical Practice*, vol. 157, p. 107843, 2019.
- [4] A. Saxe-Custack and L. Weatherspoon, "A patient-centered approach using community-based paraprofessionals to improve self-management of type 2 diabetes," *American Journal of Health Education*, vol. 44, no. 4, pp. 213–220, 2013.
- [5] D. E. Bloom, E. T. Cafiero, E. Jané-Llopi et al., *The Global Economic Burden of Noncommunicable Diseases*, World Economic Forum, Geneva, 2011.
- [6] P. E. Pemu, A. Q. Quarshie, R. Josiah-Willock, F. O. Ojutalayo, E. Alema-Mensah, and E. O. Ofili, "Socio-demographic psychosocial and clinical characteristics of participants in e-HealthyStrides©: an interactive ehealth program to improve diabetes self-management skills," *Journal of health care for the poor and underserved*, vol. 22, no. 4A, pp. 146–164, 2011.
- [7] L. Fan and S. Sidani, "Effectiveness of diabetes self-management education intervention elements: a meta-analysis," *Canadian Journal of Diabetes*, vol. 33, no. 1, pp. 18–26, 2009.
- [8] L. Schinckus, S. Van den Broucke, and M. Housiaux, "Assessment of implementation fidelity in diabetes self-management education programs: a systematic review," *Patient Education and Counseling*, vol. 96, no. 1, pp. 13–21, 2014.
- [9] J. Chodosh, S. C. Morton, and W. Mojica, "Meta-analysis: chronic disease self-management programs for older adults," *Annals of Internal Medicine (Philadelphia, PA)*, vol. 143, no. 6, pp. 427–438, 2005.
- [10] S. L. Norris, J. Lau, S. J. Smith, C. H. Schmid, and M. M. Engelgau, "Self-management education for adults with type 2 diabetes: a meta-analysis of the effect on glycemic control," *Diabetes Care*, vol. 25, no. 7, pp. 1159–1171, 2002.
- [11] A. Bandura, "Self-efficacy: toward a unifying theory of behavioral change," *Psychological review*, vol. 84, no. 2, pp. 191–215, 1977.

- [12] A. Coulter and J. Ellins, *Patient-Focused Interventions a Review of the Evidence*. Picker Institute Europe, The Health Foundation, 2006.
- [13] J. W. Anderson, C. W. Kendall, and D. J. Jenkins, "Importance of weight management in type 2 diabetes: review with meta-analysis of clinical studies," *Journal of the American college of nutrition*, vol. 22, no. 5, pp. 331–339, 2003.
- [14] S. A. Boren, K. A. Fitzner, P. S. Panhalkar, and J. E. Specker, "Costs and benefits associated with diabetes education: a review of the literature," *The Diabetes Educator*, vol. 35, no. 1, pp. 72–96, 2009.
- [15] I. Duncan, C. Birkmeyer, S. Coughlin, Q. E. Li, D. Sherr, and S. Boren, "Assessing the value of diabetes education," *The Diabetes Educator*, vol. 35, no. 5, pp. 752–760, 2009.
- [16] E. W. Gregg, H. Chen, L. E. Wagenknecht et al., "Association of an intensive lifestyle intervention with remission of type 2 diabetes," *Journal of the American Medical Association*, vol. 308, no. 23, pp. 2489–2496, 2012.
- [17] A. L. Martin and R. D. Lipman, "The future of diabetes education: expanded opportunities and roles for diabetes educators," *The Diabetes Educator*, vol. 39, no. 4, pp. 436–446, 2013.
- [18] F. Morrison, M. Shubina, and A. Turchin, "Lifestyle counseling in routine care and long-term glucose, blood pressure, and cholesterol control in patients with diabetes," *Diabetes Care*, vol. 35, no. 2, pp. 334–341, 2012.
- [19] L. Minet, S. Moller, W. Vach, L. Wagner, and J. E. Henriksen, "Mediating the effect of self-care management intervention in type 2 diabetes: A meta-analysis of 47 randomised controlled trials," *Patient education and counseling*, vol. 80, no. 1, pp. 29–41, 2010.
- [20] A. Steinsbekk, L. Rygg, M. Lisulo, M. B. Rise, and A. Fretheim, "Group based diabetes self-management education compared to routine treatment for people with type 2 diabetes mellitus. A systematic review with meta-analysis," *BMC Health Services Research*, vol. 12, no. 1, p. 213, 2012.
- [21] L. M. Martire, R. Schulz, V. S. Helgeson, J. S. Brent, and E. M. Saghafi, "Review and meta-analysis of couple-oriented interventions for chronic illness," *Annals of Behavioral Medicine*, vol. 40, no. 3, pp. 325–342, 2010.
- [22] V. D. Sousa, J. A. Zangniewski, C. M. Musil, P. J. Price Lea, and S. A. Davis, "Relationships among self-care agency, self-efficacy, self-care, and glycemic control," *Research and Theory for Nursing Practice*, vol. 19, pp. 217–230, 2006.
- [23] S. A. Boren, T. L. Gunlock, J. Schaefer, and A. Albright, "Reducing risks in diabetes self-management: a systematic review of the literature," *The Diabetes Educator*, vol. 33, no. 6, pp. 1053–1077, 2016.
- [24] T. Deakin, C. Mcshane, J. Cade, and R. Williams, "Group based training for self-management strategies in people with type 2 diabetes mellitus," *Cochrane database of systematic reviews*, vol. 18, no. 2, 2005.
- [25] E. Kumah, "Self-management education: a self-care intervention in healthcare quality improvement," *SelfCare*, vol. 8, no. 2, pp. 11–18, 2017.
- [26] D. Schillinger, J. Piette, K. Grumbach et al., "Closing the loop: physician communication with diabetic patients who have low health literacy," *archives of internal medicine*, vol. 163, no. 1, pp. 83–90, 2003.
- [27] P. Kar, "Social media in diabetes: bane or boon?," *Practical Diabetes*, vol. 30, no. 1, p. 36, 2013.
- [28] D. Willens, R. Cripps, R. Wilson, and R. R. Wolff, "Interdisciplinary team care for diabetic patients by primary care physicians, advanced practice nurses, and clinical pharmacists," *Clinical Diabetes*, vol. 29, no. 2, pp. 60–68, 2011.
- [29] S. Saxena, T. Misra, J. Car, N. Gopalakrishnan, R. Smith, and A. Majeed, "Systematic review of primary healthcare interventions to improve diabetes outcomes in minority ethnic groups," *Journal of Ambulatory Care Management*, vol. 30, no. 3, pp. 218–230, 2007.
- [30] M. B. Davidson, "The effectiveness of Nurse- and Pharmacist-Directed care in diabetes disease Management:A narrative review," *Current Diabetes Reviews*, vol. 3, no. 4, pp. 280–286, 2007.
- [31] K. G. Shojania, S. R. Ranji, K. M. McDonald et al., "Effects of quality improvement strategies for type 2 diabetes on glycemic control: a meta-regression analysis," *JAMA*, vol. 296, no. 4, pp. 427–440, 2006.
- [32] M. A. Chisholm-Burns, J. Kim Lee, C. A. Spivey et al., "US Pharmacists' effect as team members on patient Care," *Medical Care*, vol. 48, no. 10, pp. 923–933, 2010.
- [33] M. Machado, J. Bajcar, G. C. Guzzo, and T. R. Einarson, "Sensitivity of patient outcomes to pharmacist interventions. Part I: systematic review and meta-analysis in diabetes management," *Annals of pharmacotherapy*, vol. 41, no. 10, pp. 1569–1582, 2007.
- [34] D. P. Wubben and E. M. Vivian, "Effects of pharmacist outpatient interventions on adults with diabetes mellitus: a systematic review," *Pharmacotherapy*, vol. 28, no. 4, pp. 421–436, 2008.
- [35] E. Loveman, P. Royle, and N. Waugh, "Specialist nurses in diabetes mellitus," *Cochrane Database Systematic Review*, vol. 2, 2003.
- [36] G. Welch, J. Garb, S. Zagarins, I. Lendel, and R. A. Gabbay, "Nurse diabetes case management interventions and blood glucose control: results of a meta-analysis," *Diabetes Research and Clinical Practice*, vol. 88, no. 1, pp. 1–6, 2010.
- [37] C. Antoline, A. Kramer, and M. Roth, "Implementation and methodology of a multidisciplinary disease-state-management program for comprehensive diabetes care," *The Permanente Journal*, vol. 15, no. 1, pp. 43–48, 2011.
- [38] P. Aschner, J. LaSalle, and M. McGill, "The team approach to diabetes management: partnering with patients; global partnership for effective diabetes management," *International Journal of Clinical Practice. Supplement*, vol. 157, pp. 22–30, 2007.
- [39] C. Codispoti, M. R. Douglas, T. McCallister, and A. Zuniga, "The use of a multidisciplinary team care approach to improve glycemic control and quality of life by the prevention of complications among diabetic patients," *The Journal of the Oklahoma State Medical Association*, vol. 97, pp. 201–204, 2004.
- [40] M. McGill and A. M. Felton, "New global recommendations: a multidisciplinary approach to improving outcomes in diabetes," *Primary Care Diabetes*, vol. 1, no. 1, pp. 49–55, 2007.
- [41] M. D. J. Peters, C. M. Godfrey, P. McInerney, C. B. Soares, H. Khalil, and D. Parker, *The Joanna Briggs Institute Reviewers' Manual 2015: Methodology for JBI Scoping Reviews*, The Joanna Briggs Institute, Adelaide, 2015, http://joannabriggs.org/assets/docs/sumari/Reviewers-Manual_Methodology-for-JBI-Scoping-Reviews_2015_v2.pdf.
- [42] D. Moher, L. Shamseer, M. Clarke et al., "Preferred reporting items for systematic review and metaanalysis protocols

- (PRISMA-P) 2015 statement,” *Systematic Reviews*, vol. 4, no. 1, p. 1, 2013.
- [43] H. Arksey and L. O’Malley, “Scoping studies: towards a methodological framework,” *International Journal of Social Research Methodology: Theory and Practice*, vol. 8, no. 1, pp. 19–32, 2005.
- [44] K. Merakou, A. Knithaki, G. Karagerogos, D. Theodoridis, and A. Barbouni, “Group patient education: effectiveness of a brief intervention in people with type 2 diabetes mellitus in primary health care in Greece: a clinically controlled trial,” *Health Education Research*, vol. 30, no. 2, pp. 223–232, 2015.
- [45] K. Kazawa, Y. Takeshita, N. Yorioka, and M. Moriyama, “Efficacy of a disease management program focused on acquisition of self-management skills in pre-dialysis patients with diabetic nephropathy: 24 months follow-up,” *Journal of nephrology*, vol. 28, no. 3, pp. 329–338, 2015.
- [46] P. A. Dyson, S. Beatty, and D. R. Mathews, “An assessment of lifestyle video education for people newly diagnosed with type 2 diabetes,” *Journal of human nutrition and dietetics*, vol. 23, pp. 355–359, 2010.
- [47] K. Brunisholz, P. Briot, S. Hamilton et al., “Diabetes self-management education improves quality of care and clinical outcomes determined by diabetes bundle measure,” *Journal of multidisciplinary healthcare*, vol. 7, p. 533, 2014.
- [48] K. Kazawa and M. Moriyama, “Effects of a self-management skills-acquisition program on pre-dialysis patients with diabetic nephropathy,” *Nephrology Nursing Journal*, vol. 40, no. 2, pp. 141–8; quiz 149, 2013.
- [49] J. J. Gagliardino, V. Arrechea, D. Assad et al., “Type 2 diabetes patients educated by other patients perform at least as well as patients trained by professionals,” *Diabetes/Metabolism Research and Reviews*, vol. 29, no. 2, pp. 152–160, 2013.
- [50] L. Ø. Rygg, M. By-Rise, K. Grønning, and A. Steinsbeckk, “Efficacy of ongoing group based diabetes self-management education for patients with type 2 diabetes mellitus. A randomised controlled trial,” *Patient education and counseling*, vol. 86, no. 1, pp. 98–105, 2012.
- [51] N. C. Pena-Purcell, M. M. Bogges, and N. Jimenez, “An empowerment-based diabetes self-management education Program for Hispanic/Latinos,” *The Diabetes Educator*, vol. 37, no. 6, pp. 770–779, 2011.
- [52] M. C. Huang, H. S. Wang, C. C. Hsu, and S. J. Shin, “Prospective randomized controlled trial to evaluate effectiveness of registered dietitian-led diabetes management on glycemic and diet control in a primary care setting in Taiwan,” *Diabetes Care*, vol. 33, no. 2, pp. 233–239, 2010.
- [53] M. Song, M. Choe, K. S. Kim et al., “An evaluation of web-based education as an alternative to group lectures for diabetes self-management,” *Nursing & Health Sciences*, vol. 11, no. 3, pp. 277–284, 2009.
- [54] N. A. Banister, S. T. Jastrow, and V. Hodges, “Diabetes self-management training program in a community clinic improves patient outcomes at modest cost,” *Journal of the American Dietetic Association*, vol. 104, no. 5, pp. 807–810, 2004.
- [55] A. N. Goudswaard, R. P. Stolk, N. P. A. Zuithoff, H. W. De Valk, and G. E. H. M. Rutten, “Long-term effects of self-management education for patients with type 2 diabetes taking maximal oral hypoglycaemic therapy: a randomized trial in primary care,” *Diabetic Medicine*, vol. 21, pp. 491–496, 2014.
- [56] C. D. Samuel-Hodge, T. C. Keyserling, S. Park, L. F. Johnston, Z. Gizlice, and S. I. Bangdiwala, “A randomized trial of a church-based diabetes self-management program for African Americans with type 2 diabetes,” *The Diabetes Educator*, vol. 35, no. 3, pp. 439–454, 2009.
- [57] R. E. Glasgow, S. M. Boles, H. G. McKay, E. G. Feil, and M. Barrera Jr., “The D-Net diabetes self-management program: long-term implementation, outcomes, and generalization results,” *Preventive Medicine*, vol. 36, no. 4, pp. 410–419, 2003.
- [58] P. L. Rickheim, J. L. Flader, T. W. Weaver, and D. M. Kendall, “Assessment of group versus individual diabetes education: a randomized study,” *Diabetes Care*, vol. 25, no. 2, pp. 269–274, 2002.
- [59] T. A. Deakin, J. E. Cade, R. Williamst, and D. C. Greenwood, “Structured patient education: the diabetes X-PERT programme makes a difference,” *Diabetic Medicine*, vol. 23, no. 9, pp. 944–954, 2006.
- [60] D. Vincent, “Culturally tailored education to promote lifestyle change in Mexican Americans with type 2 diabetes,” *Journal of the American Academy of Nurse Practitioners*, vol. 21, no. 9, pp. 520–542, 2009.
- [61] S. F. Scain, R. Friedman, and J. L. Gross, “A structured educational program improves metabolic control in patients with type 2 diabetes,” *The Diabetes Educator*, vol. 35, no. 4, pp. 603–611, 2009.
- [62] J. Two-Feather, E. C. Kieffer, G. Palmisano et al., “Racial and ethnic approaches to community health (REACH) Detroit partnership: improving diabetes related outcomes among African American and Latino adults,” *American Journal of Public Health*, vol. 95, no. 9, pp. 1552–1560, 2005.
- [63] M. Davies, S. Heller, T. Skinner et al., “Effectiveness of the diabetes education and self management for ongoing and newly diagnosed (DESMOND) programme for people with newly diagnosed type 2 diabetes: cluster randomised controlled trial,” *BMJ*, vol. 336, no. 7642, pp. 491–495, 2008.
- [64] R. O. Yeung, M. Oh, and T. S. Tang, “Does a 2.5-year self-management education and support intervention change patterns of healthcare use in African American adults with type 2 diabetes?,” *Diabetic medicine*, vol. 31, no. 4, pp. 472–476, 2014.
- [65] M. K. O’Brien, K. Petrie, and J. Raeburn, “Adherence to medication regimens: updating a complex medical issue,” *Medical Care Review*, vol. 49, no. 4, pp. 435–454, 1992.
- [66] C. E. Golin, M. R. DiMatteo, and L. Gelberg, “The role of patient participation in the doctor Visit: Implications for adherence to diabetes care,” *Diabetes Care*, vol. 19, no. 10, pp. 1153–1164, 1996.
- [67] D. L. Roter, “Patient participation in the patient-provider interaction,” *Health Education Monographs*, vol. 5, pp. 281–315, 1997.
- [68] J. D. Piette, D. Schillinger, M. B. Potter, and M. Heisler, “Dimensions of patient-provider communication and diabetes self-care in an ethnically diverse population,” *Journal of General Internal Medicine*, vol. 18, no. 8, pp. 624–633, 2003.
- [69] M. L. Pearson, S. Mattke, R. Shaw, M. S. Ridgely, and S. H. Wiseman, *Patient self-management support programs: an evaluation. Final Contract Report (Prepared by RAND Health under Contract No. 282-00-0005)*, MD: Agency for Healthcare Research and Quality; AHRQ Publication, Rockville, 2007.

- [70] A. L. Garber, T. A. Elasy, D. Quinn, K. Wolff, and A. Brown, "Improving glycemic control in adults with diabetes mellitus: shared responsibility in primary care practices," *Southern Medical Journal*, vol. 95, no. 7, 2012.
- [71] A. Warsi, S. Philip, P. S. Wang, M. P. LaValley, J. Avorn, and D. H. Solomon, "Self-management education programs in chronic disease: a systematic review and methodological critique of the literature," *Archives of Internal Medicine*, vol. 164, no. 15, pp. 1641–1649, 2004.
- [72] K. R. Lorig and H. Holman, "Self-management education: history, definition, outcomes, and mechanisms," *Annals of Behavioral Medicine*, vol. 26, no. 1, pp. 1–7, 2003.