 doi:10.20944/preprints202209.0314.v1

Review

A Literature Review on Diabetes Mellitus Management: A Nursing Philosophy

Ika Nur Pratiwi[1,4*], Moses Glorino Rumambo Pandin[2], Nursalam Nursalam[3,4]

[1] Fundamental of Nursing Department, Faculty of Nursing, Universitas Airlangga, Surabaya, Indonesia
[2] Department of English Literature, Faculty of Humanities, Universitas Airlangga
[3] Advanced of Nursing Department, Faculty of Nursing, Universitas Airlangga, Surabaya, Indonesia
[4] Doctoral Program of Nursing, Faculty of Nursing, Airlangga University, Surabaya, Indonesia
* Correspondence: Corresponding Author: Ika Nur Pratiwi; Doctoral Program of Nursing, Faculty of Nursing, Airlangga University, Surabaya, Indonesia; E-mail : ikanurpratiwi@fkp.unair.ac.id

ABSTRACT: Background: Good management behavior in patients with diabetes mellitus can reduce disease complications and improve quality of life. This philosophical problem is very important for nurses who are able to provide management care for diabetic patients. The purpose of this literature review is to describe the concept, model or theory that can be used in improving the management of diabetes mellitus patients.Methods: The method used is by searching several studies published through the Scopus database, PubMed, CINAHL, SpingerLink, and web of science (WOS). The search strategy uses a combination of the terms MeSH Terms. The research questions were designed using the principles of the PICOS framework. Selected studies were published from 2017-2022.Results: A total of 15 studies were included, with 12 using quantitative methodology and 3 were qualitative. The studies were conducted across various countries. The majority of articles used the concept of self-management intervention based on digital-based development and e-health (n=6), Dorothea Orem's self-care deficit nursing theory n=2) and the transtheoretical model (n=2). These concepts, models and theories are able to improve good self-management through lifestyle changes, psychosocial, cultural acculturation and increase in spiritual values (n=6).Conclusion: Transitional change focuses on changing the modifiable factors found in the concepts, models and theories of the articles obtained. Future research can be developed to assess the existence of elaborations and modifications based on the philosophy that people with diabetes are responsible for their own health.

Keywords: Diabetes; Theory; Model; Concept; Management; Health Care

Introduction

Diabetes is a lifelong chronic disease, usually divided into type 1 and type 2 diabetes, with type 2 diabetes being the most common. In 2019, an estimated 463 million people were diagnosed with diabetes (Saeedi *et al.*, 2019). Type 2 diabetes and hyperglycemia increase the complications of diabetes, including microvascular and macrovascular diseases, such as neuropathy, myocardial infarction, stroke, and premature death (Govindarajan

 doi:10.20944/preprints202209.0314.v1

Venguidesvarane *et al.*, 2020). In addition, the incidence of DM2 has been found to be two to three times higher in South Asians in the US compared to the general population. The risk of premature death decreases in patients with good glycemic control and the absence of complications of kidney disease (Jamil *et al.*, 2022).

Lifestyle management, such as physical activity, diet, medication, and checking and controlling blood sugar is a strategic effort to reduce the risk of advanced complications in DM patients (Lew *et al.*, 2017; van der Pol, Hennessy and Manns, 2017; Meneilly *et al.*, 2018). In long-term management, it is important for patients to actively participate in controlling through participation in education, diet planning, physical activity and insulin-drugs (Perkeni, 2015a). Research has shown that patients with good self-management behavior have a lower risk of complications and a higher quality of life (Emery *et al.*, 2019; Govindarajan Venguidesvarane *et al.*, 2020). This philosophical problem is very important because it affects the theory that can be used, the attitude of nurses in providing education and care (cognitive, affective, and behavioral), and every material and interaction in the management of diabetes mellitus patients (Kalra, Baruah and Kalra, 2017).

There are several concepts, models or theories that are used in the management of diabetes mellitus patients, both on an individual basis and involving families and health workers with the aim of increasing the ability and compliance of diabetes mellitus patients in self-management. Self-management as part of self-care, both are based on the philosophy that individuals are responsible for their own health (Gumbs, 2020; Rumahboro, Karjatin and Hamzah, 2021). In accordance with the principles in nursing philosophy, the central core of nursing is the nurse-patient relationship (Skinner *et al.*, 2003; Kalra, Baruah and Kalra, 2017). Therefore, the purpose of this literature review is to describe the concept, model or theory that can be used in improving the management of diabetes mellitus patients.

Methods

This study uses tertiary data in the form of a literature review of several relevant article references. Data were obtained through the Scopus database, PubMed, CINAHL, SpingerLink, and web of science (WOS). The purpose of this LR is to synthesize articles about an effective concept, model or theory as an approach used in the management of patients with diabetes mellitus.

Eligibility criteria

Search the literature using keywords adapted to Medical Subject Heading (MeSH), namely *"Conceptual model"* OR *"nursing theory"* OR "*conceptual framewor*k" OR "*nursing model*" AND "*self-management*" OR *management* AND *Diabetes* OR "*Diabetes mellitus*". The strategy used to find articles using the PICOS framework consists of:

1. *Population/problem,* namely the population or problem to be analyzed in accordance with the themes that have been determined in the literature review.
2. *Intervention* is an action or intervention that is applied to the research subject in accordance with the themes that have been determined in the literature review.

 doi:10.20944/preprints202209.0314.v1

3. *Comparation,* which is a comparison of the interventions that have been implemented.
4. *Outcomes* are the results or outcomes obtained from previous studies that are in accordance with the themes that have been determined in the literature review.
5. *Study design,* namely the research design used in the article to be reviewed.

The articles taken must meet the inclusion criteria: 1) English-language articles, 2) obtained from journals published in 2017 to 2022, 3) full-text available. The search string is constructed using a combination of MeSH subject titles, thesaurus, and free text keywords as follows:

1. Pubmed:

("Conceptual model"[All Fields] OR "nursing theory"[All Fields] OR "conceptual framework"[All Fields] OR "nursing model"[All Fields]) AND ("self-management"[All Fields] OR ("manage"[All Fields] OR "managed"[All Fields] OR "management s"[All Fields] OR "managements"[All Fields] OR "manager"[All Fields] OR "manager s"[All Fields] OR "managers"[All Fields] OR "manages"[All Fields] OR "managing"[All Fields] OR "managment"[All Fields] OR "organization and administration"[MeSH Terms] OR ("organization"[All Fields] AND "administration"[All Fields]) OR "organization and administration"[All Fields] OR "management"[All Fields] OR "disease management"[MeSH Terms] OR ("disease"[All Fields] AND "management"[All Fields]) OR "disease management"[All Fields])) AND ("diabete"[All Fields] OR "Diabetes mellitus"[MeSH Terms] OR ("diabetes"[All Fields] AND "mellitus"[All Fields]) OR "Diabetes mellitus"[All Fields] OR "diabetes"[All Fields] OR "diabetes insipidus"[MeSH Terms] OR ("diabetes"[All Fields] AND "insipidus"[All Fields]) OR "diabetes insipidus"[All Fields] OR "diabetic"[All Fields] OR "diabetics"[All Fields] OR "diabets"[All Fields] OR "Diabetes mellitus"[All Fields])

2. Scopus

TITLE-ABS-KEY (("Conceptual model" OR "nursing theory" OR "conceptual framework" OR "nursing model") AND ("self-management" OR management) AND (diabetes OR "Diabetes mellitus")) AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017)) AND (LIMIT-TO (DOCTYPE , "ar"))

3. WOS

("Conceptual model" OR "nursing theory" OR "conceptual framework" OR "nursing model") AND ("self-management" OR management) AND (Diabetes OR "Diabetes mellitus") (Topic) and 2022 or 2021 or 2020 or 2019 or 2018 or 2017 (Publication Years)

4. CINAHL

("Conceptual model" OR "nursing theory" OR "conceptual framework" OR "nursing model") AND ("self-management" OR management) AND (Diabetes OR "Diabetes mellitus") (Topic) and 2022 or 2021 or 2020 or 2019 or 2018 or 2017 (Publication Years).

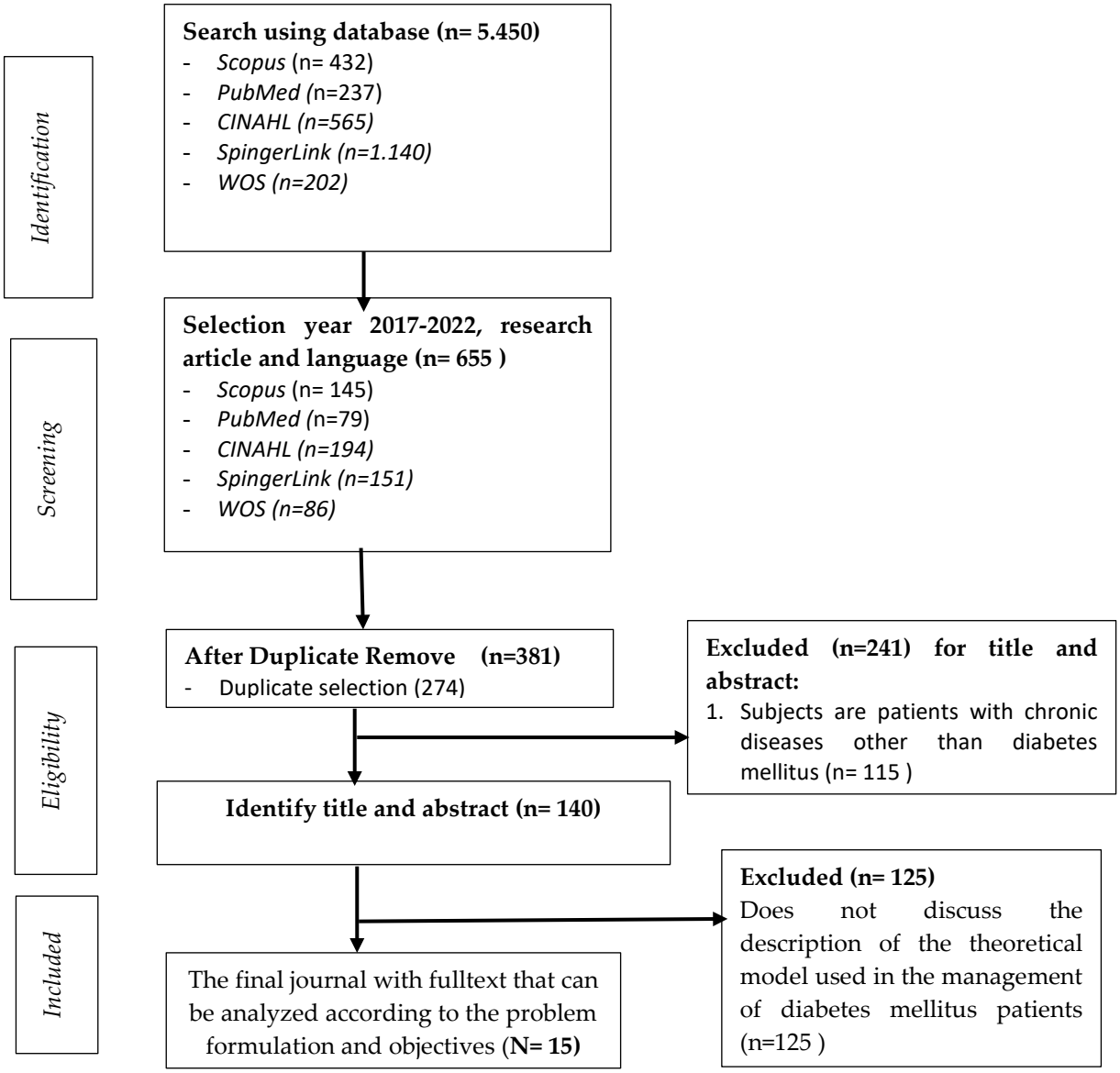
5. SpingerLink

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 21 September 2022 doi:10.20944/preprints202209.0314.v1

'("Conceptual model" OR "nursing theory" OR "conceptual framework" OR "nursing model") AND ("self-management" OR management) AND (Diabetes OR "Diabetes mellitus")' 2017 - 2022 Remove this filter

Study selection

Based on the results of a literature search on five databases using keywords that have been adapted to MeSH, the researchers identified 5,450 journals. Then three reviewers (INP, MGR and NN) independently screened all identified articles based on the 2017-2022 limit and using English the results left 655 articles including Scopus (n= 145), PubMed (n=79), CINAHL (n=194), SpingerLink (n=151) and WOS (n=86). Next, the duplication of the five databases was selected (n=274). The next stage is eligibility by excluding titles and abstracts whose research subjects are not focused on diabetes mellitus patients (n = 115) and the type of review article (n = 126). The next step is to search for the availability of full text articles and exclude full text articles that do not discuss the description of the theoretical model used in the management of diabetes mellitus patients (n = 125) (figure 1).



 doi:10.20944/preprints202209.0314.v1

Figure 1 Flow chart of the literature search and screening process.

Results

Characteristics of the selected studies

Table 1 shows the results obtained by 15 articles with limitations in 2017-2022 and using English consisting of 3 articles with a randomized controlled trial design, 1 article with a Quazi-experimental design, 1 article with a mixed-methods study design, 5 articles with cross sectional study design, 1 article with Case study design, 3 articles with qualitative study and 1 article with Research and Development design. Two articles are from the UK and 5 articles are from the USA. The rest are spread by 1 article each from Sweden, China, Malaysia, Iran, Nigeria, Taiwan and the Netherlands.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 21 September 2022 doi:10.20944/preprints202209.0314.v1

Table 1. Characteristics of Study Literature

No.	Judul, Penulis, Tahun	Design	Country	Participants	Objective	Measures
1	*Individual goal-based plan based on nursing theory for adults with type 2 diabetes and self-care deficits: a study protocol of a randomised controlled trial* (Rosman *et al.*, 2022)	*Randomised controlled trial*	Sweden	110 patients diabetes over the age of 18 years will be included if they have HbA1c ≥58mmol/mol and a diabetes duration ≥5 years	To determine whether a written, theory-based, individual goal-based plan for patients with type 2 diabetes and self-management deficits can affect their glycaemic control and health-related quality of life, as well as their experiences of living with diabetes and of support from diabetes care.	Checking glycosylated hemoglobin levels, RAND-36 questionnaire, and the Diabetes questionnaire
2	Understanding and measuring adaptation level among community-dwelling patients with metabolic syndrome: A cross-sectional survey (Wang, Shao and Ye, 2020)	Cross-sectional study	China	144 adults with metabolic syndrome	To translate the Roy adaptation model concept of adaptation level into measurable concepts when considering the health-related quality of life, social support, and self-efficacy of community-dwelling Chinese adults with metabolic syndrome	Environmental stimuli (sociodemographic characteristics), adaptation level (health-related quality of life and social support), and prerequisite of behavior (self-efficacy) questionnaires
3	The Internal Realities of Individuals With Type 2 Diabetes: Mediators Influencing Self-Management Beliefs via Grounded Theory	*Qualitative study (grounded theory)*	Malaysia	10 Type 2 diabetes mellitus patients and health care professionals (HCP)	To discover psychosocial mediators that influence and support selfmanagement beliefs in T2D patients	in-depth interviews

 doi:10.20944/preprints202209.0314.v1

	Approach (Swarna Nantha *et al.*, 2020)					
4	Self-management Intervention Program Based on the Health Belief Model (HBM) among Women with Gestational Diabetes Mellitus: A Quazi-Experimental Study (Mohebbi *et al.*, 2019).	*Quazi-experimental*	Iran	110 women 17–41 years with gestational diabetes mellitus (GDM)	To determine the effect of theory-based intervention program among women with gestational diabetes mellitus (GDM).	Health Belief Model (HBM) and self-management questionnaire and Checking glycosylated hemoglobin levels
5	Applying two minds theory to self-management of Type 1 diabetes (Messer, Sousa and Cook, 2019).	*cross sectional study*- Descriptive Applied Theory	Colorado	Type 1 diabetes patients	To conscious beliefs about past events and behavioral intentions for the future, both of which become part of the material considered by the intuitive system in selecting future behaviors.	Interviewed practice nurses.
6	A nurse-led conceptual model to inform patient-centred, type 2 diabetes mellitus management in public clinical settings (Marsala-Cervasio *et al.*, 2021)	*Qualitative study*	Nigeria	Nurse caring for diabetic patients	To develop a conceptual model to promote patient-centred type 2 diabetes mellitus care in clinical settings. We explored nurses' contextual perceptions of clinical practices and operations in light of type 2 diabetes mellitus management across public hospitals in Lagos, Nigeria. Identifying a nurse-led intervention is critical to care optimisation for people diagnosed with type 2 diabetes mellitus.	Semistructured questions and interviewed practice nurses.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 21 September 2022 doi:10.20944/preprints202209.0314.v1

7	Interprofessional Collaborative Practice Model to Advance Population Health (Shirey *et al.*, 2021)	*cross sectional study - Descriptive Applied Theory*	Alabama	104 diabetic patients	To describe the development, implementation, and lessons learned associated with an interprofessional collaborative practice (IPCP) care delivery model initiated at the University of Alabama at Birmingham (UAB).	Interviewed practice nurses.
8	Orem's Select Basic Conditioning Factors And Health Promoting Self-Care Behaviors Among African American Women With Type 2 Diabetes (Gumbs, 2020).	*Cross Sectional Study*	New York, NY, United States of America	Secondary data analysis of the 2017 BRFSS data set described the sample of African-American women with T2D.	To determine which o f the Basic Conditioning Factors (BCF) predicted health-promoting self-care behaviors in African American women (AMW) with type 2 diabetes (T2D)	Secondary data
9	Mobile-based and cloud-based system for self-management of people with type 2 diabetes: Development and usability evaluation (Salari *et al.*, 2021)	*Research and Development*	Iran	People with type 2 diabetes	To describes the development and usability evaluation of a cloud-based and mobile-based diabetes self-management app designed to help people with diabetes change their health behavior and also enable remote monitoring by health care providers.	*mHealth solution comprises 3 phases*
10	Stages of change concept of the transtheoretical model for healthy eating links health literacy and diabetes knowledge to glycemic control in people with	*Cross-sectional*	*Taiwan*	232 patients with type 2 diabetes	The role of knowledge and stages of change (SOC) as serial mediators linking health literacy to glycemic control.	Questionnaires for assessing health literacy, readiness to consume healthy foods, and a dietary knowledge

 doi:10.20944/preprints202209.0314.v1

	type 2 diabetes (Tseng *et al.*, 2017)					test specific to diabetes
11	Pump It Up! A randomized clinical trial to optimize insulin pump self-management behaviors in adolescents with type 1 diabetes (O'Donnell *et al.*, 2021)	Larger randomized clinical trial	*United States*	130 adolescent with type 1 diabetes and caregiver dyads	To use objectively downloaded insulin pump data to inform and test two interventions to optimize insulin pump use in adolescents with T1D and their caregivers.	Checking glycosylated hemoglobin levels and questionnaires
12	Medication adherence and health beliefs among South Asian immigrants with diabetes in the United States: A qualitative study (Jamil *et al.*, 2022)	*Qualitative study*	*United States*	12 South Asian immigrants in the U.S. with CVD and/or Diabetes mellitus type 2 (DM2)	To explore how cultural perspectives of South Asian immigrants in the U.S. impact adherence to medications for DM2 and CVD.	Semi-structured interviews
13	Information and communication technology enabling partnership in person-centred diabetes management: Building a theoretical framework from an inductive case study in the Netherlands (Wildevuur *et al.*, 2019)	Case study	Netherlands	6 patients with type 1 diabetes, 5 healthcare professionals (2 medical specialists and 3 diabetes nurses), and 1 policy advisor from the Ministry of Health, Welfare and Sport	To construct a theoretical framework for information and communication technology (ICT)-enabled partnership towards diabetes management.	Interviewed
14	Evaluation of the digital diabetes prevention programme pilot: Uncontrolled mixed-methods study	*A mixed-methods study*	London, UK	Adults diabetes mellitus patients	To determine whether, and if so, how, should NHSE implement a national digital diabetes prevention programme (DDPP)	Clinical data and questionnaires

 doi:10.20944/preprints202209.0314.v1

	protocol (Murray *et al.*, 2019)					
15	A digital self-management intervention for adults with type 2 diabetes: Combining theory, data and participatory design to develop HeLP-Diabetes (Dack *et al.*, 2019)	*Randomised controlled trial*	London, UK	20 People with type 2 diabetes and 18 Health Care Professionals	To describe the development process and content of a digital self-management intervention for people with type 2 diabetes (HeLP-Diabetes) that has been found to achieve its target clinical outcome, the reduction of HbA1c, a measure of glycaemic control	Interviewed and questionnaires

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 21 September 2022 doi:10.20944/preprints202209.0314.v1

Approach Theory, Model or Concept Used

From the literature search conducted to improve self-management of patients with diabetes mellitus, there were 6 articles focusing on the concept of digital-based and e-health-based self-management interventions (Tseng *et al.*, 2017; Dack *et al.*, 2019; Murray *et al.*, 2019; Wildevuur *et al.*, 2019; O'Donnell *et al.*, 2021; Salari *et al.*, 2021). Then other articles focus on the concepts: 1) the grounded theory approach found a functional framework for psychosocial mediators that influence self-management beliefs in patients with type 2 diabetes mellitus (T2DM) (Swarna Nantha *et al.*, 2020), 2) Interprofessional collaborative practice (IPCP) (Shirey *et al.*, 2021) and 3) Person-centred care (PCC) (Wildevuur *et al.*, 2019).

A total of 3 articles were obtained about the model found in the article: 1) Health belief model (HBM) (Mohebbi *et al.*, 2019), 2) a nurse-led intervention model (Marsala-Cervasio *et al.*, 2021), 3) Pump It Up model (Wildevuur *et al.*, 2019; O'Donnell *et al.*, 2021). A total of 2 articles use Dorothea Orem's self-care deficit nursing theory Orem (Gumbs, 2020; Rosman *et al.*, 2022) and the transtheoretical model (TTM) (Tseng *et al.*, 2017; Salari *et al.*, 2021). 1 article each using Helson's level of adaptation theory (Wang, Shao and Ye, 2020) and Two minds theory (TMT) (Messer, Sousa and Cook, 2019).

Table 2. Results finding from the literature

No.	First Author and Year	The theory, model or concept used	Impact on the management of diabetes mellitus patients
1	Rosman *et al.*, (2022)	Development of individual management plans based on Dorothea Orem's theory of self-care deficit nursing as an instrument to facilitate more individualized self-care support for patients with type 2 diabetes. According to Orem's theory of self-care deficit nursing, self-care is a human need, and nursing care is needed in self-care deficit situation. The ontological assumption for nursing from Dorothea Orem is that humans are unique individuals with the same basic needs to maintain living conditions.	Self-management is defined as part of self-care, both based on the philosophy that individuals are responsible for their own health. Self-management is defined as 'abilities' individuals, in conjunction with families, communities and health professionals to manage symptoms, treatments, lifestyle changes and psychosocial, cultural and spiritual consequences of health conditions. So based on Orem's theory, the nurse's role is to support, teach, guide, and provide an environment that supports personal development.
2	Wang, Shao and Ye (2020)	Helson's degree of adaptation theory describes humans as adaptive systems because they can adapt to changing environmental conditions. As noted in the Middle-Range Theory of Adaptation to Chronic Illness (MRT-ACI), which is derived from the Roy Adaptation Model (RAM), defined concepts such as excitability and degree of adaptation are implemented in	In this study, Diabetes Mellitus patients felt a level of adaptation by performing self-management that improved their quality of life and received social support. In addition, sociodemographic characteristics and lifestyle behavior (identified as environmental stimuli) are considered as important personal factors

 doi:10.20944/preprints202209.0314.v1

		empirical studies. Overall, the level of adaptation is influenced by stimuli and can be operationalized as an individual's inner capacity based on physiological and psychosocial aspects. It predicts the effectiveness of health behaviors.	that promote self-efficacy (considered a behavioral prerequisite) in disease management.
3	Swarna Nantha *et al.*, (2020)	Based on the grounded theory approach, it is found that the functional framework for psychosocial mediators that influence self-management beliefs in type 2 diabetes mellitus (T2DM) patients is designed and characterized by 4 main processes: (1) health promotion, (2) personal expectations, (3) care-centered in someone with DM, and (4) psychosocial support. Meeting the patient's personal expectations is at the core of better self-management beliefs.	It is evident that the psychological and physical needs of diabetics must be met before the use of any form of persuasive technique aimed at inculcating better self-management practices. Optimization of the family environment plays an important role in empowering T2DM patients to adhere to self-care practices.
4	Mohebbi et al., (2019)	The Health Belief Model (HBM) was used to examine the barriers and basis for a person's participation in disease prevention programs and the promotion of a healthy lifestyle.	The implementation of the HBM educational intervention program with a focus on the benefits of self-management has a positive impact on diabetic patients on increasing HbA1c by providing recommendations for healthy eating, weight control and incorporating physical activity into daily activities.
5	Messer, Sousa and Cook (2019)	Two minds theory (TMT) is an interdisciplinary approach to understanding health behavior. It was originally called temporal immediacy theory because it offered a new perspective on the cognitive processes involved in decision making: the Intuitive system and the narrative system, each of which has a unique function for behavior in nursing biobehavioral.	TMT has implications for nursing practice to inform new strategies in behavior change interventions. In diabetes self-management, nurses can encourage individuals to take advantage of environmental cues, reward self-management (training the intuitive system), or engage the narrative system through planning for healthier future decisions.
6	Marsala-Cervasio *et al* (2021)	Identifying a nurse-led intervention model is critical for optimizing type 2 diabetes mellitus care. Integration is considered an important pathway for optimizing T2DM management in the form of patient-centred collaboration and empowerment. The collective alliance to improve care and	Nurses provided insight into four areas of patient-centred type 2 diabetes mellitus management in clinical settings: empowering collaboration; empowering flexibility; empowering approach; and empowering practices. Nurses discussed an empowering pathway through which

 doi:10.20944/preprints202209.0314.v1

		support in T2DM spans the macro, meso and micro levels.	health settings could provide patient-centred care to individuals diagnosed with type 2 diabetes mellitus. The pathway entailed the integration of macro, meso and micro levels for patient management. Nurses' accounts have informed the development of a conceptual model for the optimization of patient care.
7	Shirey *et al* (2021)	The World Health Organization defines IPCP as ‘‘multiple health workers from different professional backgrounds working together with patients, families, and communities to deliver the highest quality of care. Effective IPCP requires the integration of 4 competency domains identified by the Interprofessional Education Collaborative, including (1) values/ethics, (2) roles/responsibilities, (3) interprofessional communication, and (4) teams and teamwork	The model emphasizes transitional care coordination in chronic disease management for underserved and vulnerable populations. The model uses a nurse-led, team-based approach that involves multiple professions working together to provide care for high-need, high-cost patients. Clinics use 4 simultaneous bundles of care that include evidence-based treatment guidelines, transitional care coordination activities, patient activation strategies, and behavioral health integration. Engaged patients indicate very high levels of satisfaction with care and improved physical and mental health outcomes resulting in significant cost savings for the health system.
8	Gumbs (2020)	Three theories contribute to Orem's self-care deficit nursing theory; (1) the theory of self - care, (2) the theory of self-care deficit, and (3) the theory of nursing systems. Orem posits that *Basic Conditioning Factors (BCF)* can interfere with therapeutic selfcare demand and the health deviation self-care requisites required by this disorder to maintain health and wellbeing.	This study contributes to nursing by demonstrating support for the utility of Orem's Self-Care Framework that incorporates universal self-care requisites and health deviation self-care requisites that form healthpromoting self-care behaviors at the conceptual model's middle-range level. Nursing must create an environment of caring that is accessible to people of all educational backgrounds, income levels, and teach individuals according to his or her level of education.
9	Salari *et al* (2021)	As the use of smartphones and mobile apps is increasing, mobile health (mHealth) can be used as a cost-effective option to provide	The developed mobile application includes modules that support several features. A person's data is entered or

		behavioral interventions aimed at educating and promoting self-management for chronic diseases such as diabetes. The development of a cloud-based and mobile-based system for people with diabetes and their health care providers used transtheoretical model (TTM) as the theoretical foundation of this system and tailored massaging for improving the acceptability of the system by the users.	collected and viewed in the form of graphs and tables. The theoretical basis for behavioral intervention is the transtheoretical model. Users can receive customized messages based on the stage of preparation for behavior change using the Kreuter algorithm. The clinician portal is used by healthcare providers to monitor patients. Mobile and cloud-based systems can be effective tools to facilitate modification of chronic care self-management. The results of this study indicate that the usability of mobile and cloud-based systems can be satisfactory and promising.
10	Tseng *et al* (2017)	Model transtheoretical (TTM) telah lama dianggap sebagai konseptualisasi yang berguna dalam proses perubahan perilaku yang disengaja. Peran pengetahuan dan stages of change (SOC) sebagai mediator serial yang menghubungkan literasi kesehatan dengan kontrol glikemik. The TTM posits that people move through five specific SOC when changing health behaviors precontemplation, contemplation, preparation, action, and maintenance.	Complete mediation model of health literacy (HL) about diabetes health through diabetes knowledge and SOC, respectively. Determinants of sociocognitive motivation including traditional social cognition constructs (eg, knowledge, beliefs, and attitudes) are considered important mediating factors in the pathway between HL and self-management.
11	O'Donnell *et al* (2021)	Adherence is conceptualized as the extent to which an individual's behaviors are consistent with medical recommendations. As diabetes technology advances, some may argue that the impact of human behavior on T1D health outcomes will be substantially reduced or even eliminated especially as hybrid closed loop systems evolve into the artificial pancreas. Pump It Up! is the first study to provide targeted intervention to improve specific T1D insulin pump self-management behaviors.	The insulin pump self-management behavior was specifically selected as a key outcome in Pump It Up! because this behavior is critical for optimizing glycemic control. Without consistently engaging in sufficient amounts of specific T1D self-management behaviors, individuals will not be able to change their A1C. intervention studies such as Pump It Up! is needed to assess how behavioral interventions can support adolescents in improving T1D self-management behaviors, and thereby reducing acute and long-term complications.

 doi:10.20944/preprints202209.0314.v1

12	Jamil *et al* (2022)	Three conceptual frameworks were used to develop the interview guide: Dimensions of Medication Adherence, the Patient Explanatory Model (also known as the Kleinman Questions), and the HOPE questions for spiritual assessment.	Five overarching themes have been identified: (1) Numerical outcomes motivate health change; (2) open communication improves medication adherence; (3) Self-management and autonomy are valued; (4) Religious/spiritual beliefs can strengthen medication adherence; and (5) Complementary and alternative medicine (CAM) augments Western medicine.
13	Wildevuur *et al.*, (2019)	People-centred care (PCC) actively engages patients in the care process as equal partners, and is able to survive chronic conditions. Patients with chronic illness must make day-to-day decisions about self-managing their illness, which affects the healthcare professional-patient partnership with respect to care services.	Information and communication technology (ICT) for healthcare—also known as eHealth can support professional-patient partnerships in PCC services and provide chronic disease management in the face of social, physical, and emotional challenges.
14	Murray *et al.*, (2019)	This model will be supported by two theoretical frameworks: one with regard to the effectiveness of the digital diabetes prevention intervention (DDPI) and another with regard to the implementation process.	The five steps of framework analysis are (1) familiarisation, (2) identifying a thematic framework; (3) indexing; (4) charting and (5) mapping and interpretation. Familiarisation will be achieved by reading and rereading transcripts, with an a priori framework based on the Consolidated Framework for Implementation Research (CFIR) used to index and chart the data. Data that cannot be coded using CFIR will be noted.
15	Dack *et al.*, (2019)	There are three key areas for creating effective self-management digital interventions for long-term conditions that will build and would benefit from a strong theoretical underpinning. These were: a) understanding the overall impact of a long-term condition on a person's life and sense of self, and the importance of taking a holistic approach to the work required for self-management (the Corbin and Strauss' model) ; b) behavior change support (as so much of diabetes management requires changes to	Digital self-management interventions for people with type 2 diabetes (HeLP-Diabetes) have been found to be used to achieve clinical outcomes, HbA1c reduction and glycemic control measures. The implementation of the self-management program development and reporting program is transparent for long-term conditions, empirically proven and has a theoretical basis.

 doi:10.20944/preprints202209.0314.v1

		behaviors such as diet and physical activity (Abraham and Michie taxonomy of behavior change techniques); and c) the challenge of ensuring that the final intervention could be effectively implemented into routine healthcare (Normalization Process Theory).	

Impact in The Management of Patients with Diabetes Mellitus

Based on the article, it was found that good self-management through lifestyle, psychosocial, cultural and spiritual changes will affect the health and quality of life of patients with diabetes mellitus (Mohebbi *et al.*, 2019; Wildevuur *et al.*, 2019; Gumbs, 2020; Wang, Shao and Ye, 2020; Jamil *et al.*, 2022; Rosman *et al.*, 2022). Social support from both families and health workers plays an important role in improving the management of diabetes mellitus patients through new strategies in behavior change interventions (Messer, Sousa and Cook, 2019; Swarna Nantha, Haque and Swarna Nantha, 2019; Marsala-Cervasio *et al.*, 2021; Shirey *et al.*, 2021). Development of digitalization applications in monitoring and programs aimed at improving self-management of diabetes mellitus, focusing on modifying self-care through increasing knowledge of diabetes and having an impact on glycemic optimization (Tseng *et al.*, 2017; Dack *et al.*, 2019; Murray *et al.*, 2019; Wildevuur *et al.*, 2019; O'Donnell *et al.*, 2021; Salari *et al.*, 2021).

Discussion

Self-management of Diabetes Mellitus patients is a strategic effort in the long-term management of DM patients that can minimize the adverse effects of DM and the complications it causes. This study aims to determine the concept, model or theory that is effective as an approach used in the management of patients with diabetes mellitus. The entire article focuses on improving the self-management of patients with diabetes mellitus. In long-term management, it is important for patients to actively participate in controlling through participation in education, diet planning, physical activity and insulin-drugs (KONSESUS PERKENI, 2015). Research has shown that patients with good self-management behavior have a lower risk of complications and a higher quality of life (Schmitt *et al.*, 2013; Liu *et al.*, 2019; Luciani *et al.*, 2021).

In improving self-management efforts of DM patients, the most widely used concepts, models or theories in this literature search are digital- and e-health-based self-management interventions (Tseng *et al.*, 2017; Dack *et al.*, 2019; Murray *et al.*, 2019; Wildevuur *et al.*, 2019; O'Donnell *et al.*, 2021; Salari *et al.*, 2021). The popularity of mobile health technology has become an opportunity for education, remote monitoring, self-management, and data collection for diabetes care (Bellei *et al.*, 2020). This opportunity can be used to provide user-centred and evidence-based self-management interventions for people with diabetes (Salari *et al.*, 2021). Meanwhile, the development of a technology called mHealth is bigger than other applications (Bellei *et al.*, 2020). mHealth is defined as "medical and public health measures supported by mobile devices, such as cell phones, personal monitoring devices, personal digital assistants and other wireless devices (Krishnan and Selvam, 2019; Wu *et al.*, 2021).

Development of digitalization applications in monitoring and programs aimed at improving self-management of diabetes mellitus, focusing on modifying self-care through increasing knowledge of diabetes and having an impact on glycemic optimization (Tseng *et al.*, 2017; Dack *et al.*, 2019; Murray *et al.*, 2019; Wildevuur *et al.*, 2019; O'Donnell *et al.*, 2021; Salari *et al.*, 2021). Uncontrolled glycemic levels are the result of a picture of DM treatment that is still not optimal. More than 40% of DM patients are unable to undergo

 doi:10.20944/preprints202209.0314.v1

therapy and healthy lifestyle modifications according to the recommendations of health workers (Pratiwi *et al.*, 2018; Shetty *et al.*, 2021). Several previous studies have shown that mobile health-based DM treatment is effective in reducing hbA1c levels and improving self-management of DM patients (Faroqi *et al.*, 2018; Ory *et al.*, 2020).

In this literature study, obtained the concept that psychosocial mediators influence self-management beliefs in patients with type 2 diabetes mellitus (T2DM) (Brenk-Franz *et al.*, 2017; Tseng *et al.*, 2017; Pratiwi, Kusnanto and Maulida, 2020). Psychosocial mediators can be designed and characterized by 4 main processes, namely health promotion, personal expectations, self-centered care for someone with DM, and psychosocial support. In addition, other concepts used are interprofessional collaborative practice (IPCP) (Shirey *et al.*, 2021) and people-centered care (PCC) (Wildevuur *et al.*, 2019). Effective IPCP requires the integration of 4 competency domains identified by the Interprofessional Education Collaborative namely values/ethics, roles/responsibilities, interprofessional communication, and team and teamwork(Yu *et al.*, 2018; Shirey *et al.*, 2020).

This study also found that the Health belief model (HBM) had a positive impact on diabetics to increase HbA1c by providing recommendations for healthy eating, weight control and incorporating physical activity in daily activities (Mohebbi *et al.*, 2019).. Several articles use nurse-led intervention models and theories (Marsala-Cervasio *et al.*, 2021) and Two minds theory (TMT) (Messer, Sousa and Cook, 2019) which focus on the role of nurses in encouraging patients with diabetes mellitus to make behavioral changes. Nurses provided insight into four areas of patient-centred type 2 diabetes mellitus management in clinical settings: empowering collaboration; empowering flexibility; empowering approach; and empowering practices. In diabetes self-management, nurses can encourage individuals to take advantage of environmental cues, reward self-management (training the intuitive system), or engage the narrative system through planning for healthier future decisions (Marsala-Cervasio *et al.*, 2021).

Our study found 2 articles using the nursing theory of self-care deficits from Dorothea Orem's self-care deficit nursing theory Orem (Gumbs, 2020; Rosman *et al.*, 2022) and the transtheoretical model (TTM) (Tseng *et al.*, 2017; Salari *et al.*, 2021). According to Orem's theory, the nurse's role is to support, teach, guide, and provide an environment that supports personal development. While the transtheoretical model (TTM) as the theoretical foundation of this system and tailored massaging for improving the acceptability of the system by the users. Determinants of sociocognitive motivation including traditional social cognition constructs (eg, knowledge, beliefs, and attitudes) are considered to be important mediating factors in the pathway between HL health literacy and self-management.

Based on articles obtained from the concepts, theories or models used, it is revealed that good self-management through lifestyle, psychosocial, cultural and spiritual changes will affect the health and quality of life of patients with diabetes mellitus (Mohebbi *et al.*, 2019; Wildevuur *et al.*, 2019; Gumbs, 2020; Wang, Shao and Ye, 2020; Jamil *et al.*, 2022; Rosman *et al.*, 2022) . Diabetes Mellitus patients feel the level of adaptation by doing self-management that improves the quality of life and gets social support. Social support from both families and health workers plays an important role in improving the management of diabetes mellitus patients through new strategies in behavior change interventions (Messer, Sousa and Cook, 2019; Swarna Nantha, Haque and Swarna Nantha, 2019; Marsala-Cervasio *et al.*, 2021; Shirey *et al.*, 2021).

Limitation

This study still has shortcomings, namely the study we use is in English, which maybe other studies in languages other than English can add insight to the findings of effective concepts, models or theories as an approach used in the management of diabetes mellitus patients based on literature reviews in the future. will come. In addition, the context of articles based on concepts, models or theories is generally a combination of several

concepts, models or theories which of course in the future there will be further updates or modifications.

Conclusion

In improving self-management efforts for DM patients, there are concepts, models or theories for digital and e-health-based self-management interventions that can be applied. Transitional change focuses on changing modifiable factors found in the development of concepts, models and theories from the articles obtained. Future research can be developed to assess the existence of elaborations and modifications based on the philosophy that people with diabetes are responsible for their own health.

Reference

Bellei, E. A. *et al.* (2020) 'Development and Assessment of a Mobile Health Application for Monitoring the Linkage among Treatment Factors of Type 1 Diabetes Mellitus', *Telemedicine and e-Health*, 26(2), pp. 205–217. doi: 10.1089/tmj.2018.0329.

Brenk-Franz, K. *et al.* (2017) 'Patient-provider relationship as mediator between adult attachment and self-management in primary care patients with multiple chronic conditions', *Journal of Psychosomatic Research*. Institute of Psychosocial Medicine and Psychotherapy, Jena University Hospital, Germany: Elsevier Inc., 97, pp. 131–135. doi: 10.1016/j.jpsychores.2017.04.007.

Dack, C. *et al.* (2019) 'A digital self-management intervention for adults with type 2 diabetes: Combining theory, data and participatory design to develop HeLP-Diabetes', *Internet Interventions*. Department of Psychology, University of Bath, Claverton Down, Bath, BA2 7AY, United Kingdom: Elsevier B.V., 17. doi: 10.1016/j.invent.2019.100241.

Emery, K. A. *et al.* (2019) 'Self and Family Management in Type 2 Diabetes: Influencing Factors and Outcomes.', *Nursing Science Quarterly*. Instructor, South Dakota State University, Sioux Falls, SD, USA: Sage Publications Inc., 32(3), pp. 189–197. doi: 10.1177/0894318419845399.

Faroqi, L. *et al.* (2018) 'Evaluating the clinical implementation of structured exercise: A randomized controlled trial among non-insulin dependent type II diabetics', *Contemporary Clinical Trials*, 74, pp. 25–31. doi: https://doi.org/10.1016/j.cct.2018.09.003.

Govindarajan Venguidesvarane, A. *et al.* (2020) 'Prevalence of Vascular Complications Among Type 2 Diabetic Patients in a Rural Health Center in South India', *Journal of Primary Care and Community Health*, 11(1). doi: 10.1177/2150132720959962.

Gumbs, J. (2020) 'OREM'S SELECT BASIC CONDITIONING FACTORS AND HEALTH PROMOTING SELF-CARE BEHAVIORS AMONG AFRICAN AMERICAN WOMEN WITH TYPE 2 DIABETES.', *Journal of Cultural Diversity*. PhD, ANP, RN is Chairperson of the Department of Nursing at Medgar Evers College, City University of New York, Brooklyn, NY: Tucker Publications, Inc., 27(2), pp. 47–52. Available at: https://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=144269714&site=ehost-live.

Jamil, A. *et al.* (2022) 'Medication adherence and health beliefs among South Asian immigrants with diabetes in the United States: A qualitative study', *JACCP Journal of the American College of Clinical Pharmacy*. UPMC Presbyterian-Shadyside, Pittsburgh, PA, United States: John Wiley and Sons Inc, 5(8), pp. 829–836. doi: 10.1002/jac5.1668.

Kalra, S., Baruah, M. P. and Kalra, B. (2017) 'Diabetes care: Evolution of philosophy', *Indian Journal of Endocrinology and Metabolism*, 21(4), pp. 495–497. doi: 10.4103/ijem.IJEM_109_17.

KONSESUS PERKENI (2015) *Pengelolaan dan Pencegahan Diabetes Melitus Tipe 2 di Indonesia 2015 (Management and Prevention of Type 2 Diabetes Mellitus in Indonesia 2015)*.

Krishnan, G. and Selvam, G. (2019) 'Factors influencing the download of mobile health apps: Content review-led regression analysis', *Health Policy and Technology*, 8(4), pp. 356–364. doi: https://doi.org/10.1016/j.hlpt.2019.09.001.

Lew, K. N. *et al.* (2017) 'Type 2 diabetes prevention and self-management among Nicaraguan ethnic minorities: findings from phase 3 of a community-based participatory research study.', *International Journal of Human Rights in Healthcare*. Assistant Professor at the Department of Nursing, University of Connecticut, Storrs, Connecticut, USA: Emerald Publishing Limited, 10(1), pp. 28–42. doi: 10.1108/IJHRH-06-2016-0007.

Liu, X. *et al.* (2019) 'The risk factors for diabetic peripheral neuropathy: A meta-analysis', *PLoS ONE*, 14(2), pp. 1–16. doi: 10.1371/journal.pone.0212574.

Luciani, M. *et al.* (2021) 'Self-care is Renouncement, Routine, and Control: The Experience of Adults with Type 2 Diabetes Mellitus.', *Clinical Nursing Research*. Department of Medicine and Surgery, University of Milano-Bicocca, Monza, Italy: Sage Publications Inc., 30(6), pp. 892–900. doi: 10.1177/1054773820969540.

Marsala-Cervasio, K. *et al.* (2021) 'A nurse-led conceptual model to inform patient-centred, type 2 diabetes mellitus management in public clinical settings', *JOURNAL OF RESEARCH IN NURSING*, 26(8), pp. 763–778. doi: 10.1177/17449871211021137.

Meneilly, G. S. *et al.* (2018) 'Insights Into the Current Management of Older Adults With Type 2 Diabetes in the Ontario Primary Care Setting', *Canadian Journal of Diabetes*, 42(1), pp. 23–30. doi: https://doi.org/10.1016/j.jcjd.2017.03.003.

Messer, L. H., Sousa, K. and Cook, P. F. (2019) 'Applying two minds theory to self-management of Type 1 diabetes.', *Research in nursing & health*. United States, 42(6), pp. 500–508. doi: 10.1002/nur.21983.

Mohebbi, B. *et al.* (2019) 'Self-management Intervention Program Based on the Health Belief Model (HBM) among Women with Gestational Diabetes Mellitus: A Quazi-Experimental Study.', *Archives of Iranian medicine*. Iran, 22(4), pp. 168–173.

Murray, E. *et al.* (2019) 'Evaluation of the digital diabetes prevention programme pilot: Uncontrolled mixed-methods study protocol', *BMJ Open*. Research Department of Primary Care and Population Health, University College London, London, United Kingdom: BMJ Publishing Group, 9(5). doi: 10.1136/bmjopen-2018-025903.

O'Donnell, H. K. *et al.* (2021) 'Pump It Up! A randomized clinical trial to optimize insulin pump self-management behaviors in adolescents with type 1 diabetes', *Contemporary Clinical Trials*. University of Colorado School of Medicine, Department of Pediatrics, Barbara Davis Center for Diabetes, 1775 Aurora Ct., Aurora, CO 80045, United States: Elsevier Inc., 102. doi: 10.1016/j.cct.2021.106279.

Ory, M. G. *et al.* (2020) 'Implementing a diabetes education program to reduce health disparities in south texas: Application of the re-aim framework for planning and evaluation', *International Journal of Environmental Research and Public Health*. Center for Population Health and Aging, Texas A&M University, College Station, TX 77843, United States: MDPI AG, 17(17), pp. 1–19. doi: 10.3390/ijerph17176312.

van der Pol, M., Hennessy, D. and Manns, B. (2017) 'The role of time and risk preferences in adherence to physician advice on health behavior change', *European Journal of Health Economics*. Health Economics Research Unit, University of Aberdeen, Foresterhill, Aberdeen, Scotland, AB25 2ZD, United Kingdom: Springer Verlag, 18(3), pp. 373–386. doi: 10.1007/s10198-016-0800-7.

Pratiwi, I. N. *et al.* (2018) 'The role of a healthy-eating educational module during Ramadan in a community health centre', *Journal of Diabetes Nursing*, 22(2). Available at: https://www.diabetesonthenet.com/resources/details/healthy-eating-educational-module-ramadan.

Pratiwi, I. N., Kusnanto, K. and Maulida, Y. E. (2020) 'The Correlation between Personality and Family Support and Subjective Well-Being for Patients with Diabetes Mellitus', *International Journal of Psychosocial and Rehabilitation*, 24(7), pp. 9162–9170.

Rosman, J. *et al.* (2022) 'Individual goal-based plan based on nursing theory for adults with type 2 diabetes and self-care deficits: a study protocol of a randomised controlled trial.', *BMJ open*, 12(3), p. e053955. doi: 10.1136/bmjopen-2021-053955.

Rumahboro, H., Karjatin, A. and Hamzah, A. (2021) 'INKOLA based on Orem's Self-Care Model and its effectiveness on the quality of life and HbA1C in children with type 1 diabetes mellitus.', *Family Medicine & Primary Care Review*. Nursing Program Study, Bandung Health Polytechnic, Indonesia.: Termedia Publishing House, 23(3), pp. 341–346. doi: 10.5114/fmpcr.2021.108201.

Saeedi, P. *et al.* (2019) 'Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045 : Results from the International Diabetes Federation Diabetes Atlas , 9 th edition', *Diabetes Research and Clinical Practice*. Elsevier Ireland Ltd, 157, p. 107843. doi: 10.1016/j.diabres.2019.107843.

Salari, R. *et al.* (2021) 'Mobile-based and cloud-based system for self-management of people with type 2 diabetes: Development and usability evaluation', *Journal of Medical Internet Research*. Department of Health Information Management, School of Allied Medical Sciences, Tehran University of Medical Sciences, Tehran, Iran: JMIR Publications Inc., 23(6). doi: 10.2196/18167.

Schmitt, A. *et al.* (2013) 'The Diabetes Self-Management Questionnaire (DSMQ): development and evaluation of an instrument to assess diabetes self-care activities associated with glycaemic control', *Journal Health and Quality of Life Outcomes*, 11(138), p. 14.

Shetty, A. *et al.* (2021) 'Health-related quality of life among people with type 2 diabetes mellitus – A multicentre study in Bangladesh', *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, 15(5), p. 102255. doi: https://doi.org/10.1016/j.dsx.2021.102255.

Shirey, M. R. *et al.* (2020) 'Sustainability of an Interprofessional Collaborative Practice Model for Population Health.', *Nursing Administration Quarterly*. University of Alabama at Birmingham School of Nursing, Birmingham: Lippincott Williams & Wilkins, 44(3), pp. 221–234. doi: 10.1097/NAQ.0000000000000429.

Shirey, M. R. *et al.* (2021) 'Interprofessional Collaborative Practice Model to Advance Population Health', *Population Health Management*. University of Alabama at Birmingham School of Nursing, Birmingham, AL, United States: Mary Ann Liebert Inc., 24(1), pp. 69–77. doi: 10.1089/pop.2019.0194.

Skinner, T. C. *et al.* (2003) 'Four Theories and a Philosophy: Self-Management Education for Individuals Newly Diagnosed With Type 2 Diabetes', *Diabetes Spectrum*, 16(2), pp. 75–80. doi: 10.2337/diaspect.16.2.75.

Swarna Nantha, Y. *et al.* (2020) 'The Internal Realities of Individuals With Type 2 Diabetes: Mediators Influencing Self-Management Beliefs via Grounded Theory Approach', *Journal of Primary Care & Community Health*. SAGE Publications Inc, 11, p. 2150132719900710. doi: 10.1177/2150132719900710.

Swarna Nantha, Y., Haque, S. and Swarna Nantha, H. (2019) 'The development of an integrated behavioural model of patient compliance with diabetes medication: a mixed-method study protocol.', *Family practice*, 36(5), pp. 581–586. doi: 10.1093/fampra/cmy119.

Tseng, H.-M. *et al.* (2017) 'Stages of change concept of the transtheoretical model for healthy eating links health literacy and diabetes knowledge to glycemic control in people with type 2 diabetes', *Primary Care Diabetes*. Department of Health Care Management, Chang Gung University, 259 Wen-Hwa 1st Rd., Kwei-Shan Area, Taoyuan City, Taiwan: Elsevier Ltd, 11(1), pp. 29–36. doi: 10.1016/j.pcd.2016.08.005.

Wang, X., Shao, J. and Ye, Z. (2020) 'Understanding and measuring adaptation level among community-dwelling patients with metabolic syndrome: A cross-sectional survey', *Patient Preference and Adherence*. Department of Nursing, Zhejiang University School of Medicine Sir Run Run Shaw Hospital, Hangzhou, China: Dove Medical Press Ltd., 14, pp. 939–947. doi: 10.2147/PPA.S248126.

Wildevuur, S. E. *et al.* (2019) 'Information and communication technology enabling partnership in person-centred diabetes management: Building a theoretical framework from an inductive case study in the Netherlands', *BMJ Open*. Vrije Universiteit Amsterdam, Amsterdam, Netherlands: BMJ Publishing Group, 9(6). doi: 10.1136/bmjopen-2018-025930.

Wu, D. *et al.* (2021) 'Patients' compliance behavior in a personalized mobile patient education system (PMPES) setting: Rational, social, or personal choices?', *International Journal of Medical Informatics*, 145, p. 104295. doi: https://doi.org/10.1016/j.ijmedinf.2020.104295.

Yu, C. H. *et al.* (2018) 'Impact of the Canadian Diabetes Association guideline dissemination strategy on clinician knowledge and behaviour change outcomes', *Diabetes Research and Clinical Practice*, 140, pp. 314–323. doi: https://doi.org/10.1016/j.diabres.2018.02.041.