



## Consumer-Oriented Evaluation of the Clinical Service Provided in Diabetic Health Education: A Prospective Observational Study

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## ABSTRACT

**Background:** Lack of knowledge and understanding about diabetes are important barriers to cure. Treatment of diabetes alone without education is not sufficient. Patient education could meet us today on our cell phones. **Aim:** Our aim is to establish an educational model for diabetic patients and evaluate its effectiveness in the clinical patient outcome. The theme of this study is diabetes education. And to know how far the prompt well-structured education could affect the clinical status and the quality of life of a poorly controlled diabetic patients. **Methods:** 702 patients with type 1 diabetes were followed for 2 years (2019, 2020), by condensed friendly education and training sessions. A conventional model groups (498 patients) were enrolled as comparative group. Our activities were mainly through direct individual approach and social media, structured in the form of visits. The study was done in a specialized clinics of diabetes (SDC) in a tertiary university hospital. We evaluated the clinical status, psychological, socio-cultural and satisfaction of the patients, pre and post education, through patient satisfaction survey. We assessed our patients at the beginning of the study, throughout, and at the time of discharge. Quantitative and qualitative data were compared statistically by paired t test and chi-square test at 0.05 level of significance. **Results:** Patients were evaluated 2 years after the interventional program. 96.7% of our patients were completely satisfied by what they have achieved through this project. The average HbA1C become less than eight in 54% of patients. Mean HbA1C drop was 2.7%. Patients with HbA1C 8-9%, BP <140/80, and LDL <3.36 mmol/l, were 46%, 51% and 79% respectively. Normal mean blood pressure of 56% of participants were 132/77. The mean LDL level of 71% of participants was 2.25. Of the participants, 27% had mean discharge of HbA1c of 7.3. Net promotor score of SDC was 85%, were promotors, passives and detractors were 87.8%, 9.5% and 2.8% respectively, P-value <0.05. **Conclusion:** Training and self-management assistance services are cost-effective and preferable to routine treatment. Education programs were more effective in lowering HbA1c. The attendees would find it useful and pleasant.

**Keywords:** Diabetic; Patients; Care; Model; Educational; Chronic.

## 1. INTRODUCTION

The study aims to improve the lives of people with diabetes and prevent its complications through innovative care, treatment, patient education, professional training and research. This is a worthy goal to struggle for Glycemic control and improvement could be achieved by structured education programs and behavioral changes (Norris, 2002; Sheikh et al. 2020). Glycemic control can preserve long-term clinical outcomes and prevent or delay the development of macro- and microvascular sequelae of diabetes (Minet et al., 2010). Effective programs are best delivered through face-to-face approach in combination with far-reaching, E-learning approach. They incorporate perceptive restructuring together with better interaction (Holman et al., 2008). Because of the economic growth, almost all people now are using online social media on their smart phones, relying on them as communication channels. Kingdom of Saudi Arabia (KSA) has the highest rank in the world of smart-phone users, according to the report of the United Nations submitted in the Conference of Trade and Development (Nathan, 2005). Healthcare researchers and providers invest this opportunity to better educate diabetic patients for better disease management. Many studies showed the advantage of using social media campaigns in patient education (Ellis, 2004). In China, the glycemic control among diabetic patients is still low, due to poor patient education (Jarvis, 2010). This study assesses the effect of social media in combination with face-to-face group education in improving the clinical status and quality of life, among multi-national type 1 diabetic patients in Saudi Arabia.

## 2. MATERIALS AND METHODS

### 2.1. Participants and sample size:

From January to December 2017-2018, a total of 702 patients with T1DM, aged from 14 to 60 years were selected as convenient sample from specialized diabetic clinics at the King Saud University Medical City Tertiary Hospital, of 920 beds. Subjects in the control group were disseminated self-educational materials and had face-to-face interview which was done routinely during examination and counseling in the outpatient and inpatient clinics as a usual care.

### 2.2. Aim of the study:

Our aim is how to make advice-giving becomes a system to treat our patients. This -two years- prospective cohort study compared the effect of health education through individual approach combined with usage of social media groups, on uncontrolled type 1 diabetes. The same group of patients subjected to pre-intervention evaluation and post-intervention evaluation. We used clinical outcome, quality of life and psychological improvement as variables to measure in the study.

### 2.3. Ethics Committee Approval and Consenting:

We had approval from Research Ethics Committee on this study of the King Saud University Medical City. All patients participated in this study signed an informed consent. The research has been approved by the Clinical research Ethics commission of the Medical College. Crafted informed consents were acquired from all patients prior to the start of this study.

### 2.4. Inclusion and Exclusion Criteria:

Patients with diabetes have been included in the study as follows: doctors diagnosed T1DM according to the guidelines of the World Health Organization (WHO), patients should have a mobile phone, gave consent to receive messages and also had the ability to understand text messages and to engage willingly in this research. Patients have also been excluded whether they have been diagnosed with type II diabetes, specific diabetes or a history of serious medical conditions such as kidney or liver failure, serious vision problems, mental illnesses or other metabolic diseases.

### 2.5. Number and frequency of sessions:

Our patients were visiting the clinic 3-5 times per week, during the first six months. Then they have had multiple visits to be followed; three visits per month to the completion of follow up. In each visit, they received the care, had their lab investigations, took their medications, attended the education sessions, and repeated the arrangement of their schedule.

### 2.6. Professional background of educators:

The doctors provided the educational related messages and selected them were board qualified and specialists in the field of diabetes research. They trained the nursing staff that sent the educational messages. The trained nurses followed up with patients with diabetes. Nurses had graduated from college or above and served for at least 3 years.

### 2.7. Data Collection Process

A qualified nurses and physicians in our unit collected the data in hard copies, soft copies on the electronic patient files, structured forms and questionnaires. Basic information on socioeconomic and demographic characteristics such as age, sex, educational achievement level, personal health and lifestyle such as a regular physical activity has been obtained. Data collected; at baseline, 6 months and 12 months, as well as at each visit. We collected data about; physical assessment results, laboratory investigation results and education program outcomes. Data on self-care activities were collected from all patients. Laboratory investigation results such as; fasting blood glucose and 2-hour postprandial glucose, LDL, BP, and glycosylated hemoglobin (HbA1c).

### 2.8. Research Tools:

We used three tools; educational program, measurement tools (physical assessment, and laboratory investigations):

### 2.9. Educational program:

Education is intended to promote responsible decision-making, issue-solving, constructive engagement with the health education group and self-care, as well as to enhance clinical performance, quality of life and fitness status. Such goals are achieved by comprehensive health education in a community given by health educators every month for more than 2 years. A total of 702 persons were invited to take part in the program. Reasons for decreasing involvement involved regular travel, job too hard, loss of confidence, and not being able to reach software applications or phone. The data obtained were socio-demographic factors, eating patterns, smoking, physical exercise, foot-body-care, capillary glycaemia self-monitoring, and medication compliance. Together with subsequent morbidity, such as obesity; hypertension; dyslipidemia; ischemic cardiac failure, including "acute myocardial infarction", angina, stroke; and other complications (neuropathy, micro-macrovascular, retinopathy). During the follow-up visits, data were obtained on different variables (HbA1c, total cholesterol, low-density lipoprotein (LDL) cholesterol, systolic blood pressure (SBP), diastolic blood pressure (DBP), high-density lipoprotein (HDL) cholesterol, and BMI). The systemic model of health education was focused on the following dimensions:

#### 2.9.1. Image education:

Patients were supplied by videos on DM which are focused on audiovisual strategies to raise understanding of the value of diabetes. Picture education will provide patients with more information regarding DM pathophysiology, impermissibility, risks, and diagnosis, while growing awareness about the significance of managing risk factors. Often members of the family would engage in picture education; they were all invited. The intervention was in the form of focus group face-to-face well-structured education sessions,

individual approach one-to-one interviews, using education curriculum and well prepared education materials. Also, these were combined with telemedicine apps, WhatsApp groups, mobile services and support groups.

### **2.9.2. Visit to the Presentation Room:**

With on-site appointments, patients may obtain basic awareness of the impact of medications on the bloodstream, the diet pattern, alternate medicine choices, insulin self-injection, dosage guidelines, alert indicators of hypoglycemia, and carbohydrate-counting strategies.

Patients subdivided into one face-to-face group discussion and individual approach through personal interviews, through which the nurse began to provide the patient with direct education and training using specific educational material aside with friendly psychological support and confidence-building talk.

The learning strategy is more pragmatic and focused on the day-to-day interactions of people dealing with an illness compared to earlier treatment approaches that were based on information. They stress the necessity of increasing the dignity and security of clinicians. There are to be continued preparation. One must learn to incorporate the information that he accumulates in daily practice.

### **2.9.3. Distribution of instructional content:**

In order to enhance diabetes self-care and to be an involved member in the whole process, our community has created a low-literacy colored brochures. Patients in the program were provided with a paper guide comprising the question-explanation resources on diabetes and care aims.

### **2.9.4. Therapy in personalized medicinal care:**

In a detailed and personally arranged diet plan, the interests, cultural context and conditions of every participant as well as the overall recovery system are addressed. Due to the difficulty of the medical and dietary problems with most patients, our staff proposed a simpler scheme named "restricted plate diet", It comprises of three sections:  $\frac{1}{2}$  plate vegetables,  $\frac{1}{4}$  plate staple food (carbohydrate) and  $\frac{1}{4}$  plate lean red meat (protein) and dishes remain variable not the same.

### **2.9.5. Personal exercise programs:**

Exercises involve riding, jogging, running, surfing, gymnastics, table tennis, and music. Physical activity goals, techniques, rates and intensities must be discussed for patients who are extremely open to the identification of challenges and to helping patients pursue alternatives. Patients that show signs of cardiac ischemia should be forwarded for further examination and diagnosis.

### **2.9.6. Groups and lectures:**

WhatsApp group and Regular Medical Meetings. Face-to-face seminars were the most common mode of presentation, and there was a monthly frequent educational lectures. The WhatsApp community offers a way of delivering quality health information for patients. If the results are usually below the defined goal levels, patients will be checked and reported on a daily basis to the WhatsApp Health Care Team or on an occasional visit to cause improvements in treatment if appropriate. The main objectives of the lectures are to offer feedback on the aim of reducing the possibility of complications, to share knowledge and methods for addressing challenges, to recommend approaches for meeting targets, to help track complications and to offer skills training.

### **2.9.7. Complication evaluation:**

The key task of the team is to examine complications (nephropathy, artery disorder, retinopathy, and neuropathy) and discover strategies for patients to exercise safe. The group offered advice on complications monitoring, established recovery schedules, evaluated success in achieving care goals, and helped establish approaches to fulfill recovery targets and prevent complications.

### **2.9.8. Modification of life style:**

The patients were also asked to evaluate if their attempts of life style change in the specified fields had influenced their life negatively or positively "a seven-graded scale" was used, indicating 'negative influence on my life' to 'positive influence on my life'. Lifestyle modification consists of weight loss; decreased saturated fat, trans-fat and cholesterol intake; lowered sodium and improved potassium intake; smoking cessation; and enhanced physical activity. Lifestyle modification elements include activity guidelines, professional diet guidance and thorough diabetes awareness. The aim is to turn the diabetes care model from a service user-focused to a patient-focused regimen and a patient-centered physician model.<sup>15</sup> Attempts of life style change is shown by

Table 6. Attempts of smoking cessation were assessed by 28% of the participants to have a negative impact, while attempts of increasing exercise were considered to have a positive influence by a majority (58%).

### 2.9.9. Systemic Healthcare Program:

To order to effectively follow this procedure, the individual must engage actively in the implementation of a recovery program, adhere to the values of self-care, make day-to-day "self-care" choices, interact openly and with adequate consistency with the team, and minimize the regular consumption of food. Boost physical exercise, feed less meals a day, blood glucose self-monitoring, increase compliance to medications, and develop insulin therapy skills.

### 2.9.10. Glycemic control self-monitoring:

Patients were advised to track their blood sugars, report values, and keep a record book for appointments. Most patients do routine blood glucose self-monitoring, report findings as advised, and review them with the health care staff. Patients should consult with the staff when goals are not met or where difficulties or obstacles are found.

### 2.9.11. Evaluation of therapeutic effect monthly:

Reinforcing care, establishing the target of wellness promotion and problem-solving everyday life are needed; doctors have specific monitoring goals for patients like HbA1c, LDL/HDL cholesterol, blood pressure, and total cholesterol. Patients need to be motivated to incorporate behavioral therapy into their everyday lives and to engage more fully in the process. Patients can interact with the staff equally and regularly. Continuous training workshops on self-care, general and specific nutrition, medications, fitness, blood sugar screening, foot care, changes in lifestyle, and tobacco smoking. What about diabetes? How am I going to know if I have diabetes? How is my diabetes going to be treated? What kind of complications are possible? How can I avoid problems with my health? How is my diabetes drug going to help me? Drug name, type of drug, what does it do? Things to look for. Diabetes ABCs, "A" stands for "A1C," "B" stands for "blood pressure," "C" stands for "cholesterol".

Diabetic patients have all provided traditional medical care and diabetes nursing education and will also be driven by telemedicine applications, WhatsApp groups, mobile services and support groups. We were responsible for sending and describing the information related to diabetes to our patients, including blood glucose self-monitoring, a healthy lifestyle, physical exercise, adherence with prescribed medication, low and high blood glucose regulation, and weight control for diabetes patients.

### 2.9.12. Improvement proposed measures:

A more development program was formulated on the grounds of medication effectiveness, blood pressure, risks and allergic reactions. Repeated nutritional histories and subsequent minor improvements discussed every several weeks to months by the community render it easier to determine how the adjustments already accepted have been adopted, to reinforce the value of nutritional measures, and to enable patients to exercise good food options.

### 2.9.13. Personal follow-up scheme:

Effective follow-up will be an important part of the long-term maintenance. The patient follow-up program covered follow-up duration, risk conditions, foot protection, insulin self-injection, early symptoms of hypoglycemia, diabetes-related problems, and hypoglycemia. Such initiatives will regularly enhance behavioral improvement and long-term sustainability.

## 2.10. Measurement tools

All patients underwent physical assessments, which include vitals, anthropometric measures (such as height, weight, BMI) and blood chemical tests (such as glucose levels, glycosylated hemoglobin, LDL, and triglycerides) were carried out by medical professionals using conventional methods. Patient evaluation was set up; pre and post intervention, through measurement of glycosylated hemoglobin, baseline and discharge glycosylated hemoglobin, Measurement of blood pressure, and LDL. Measurement of patient satisfaction through patient satisfaction survey and evaluation of patients' feelings and self-esteem by; Net promoter score, SDC score, diabetes knowledge score, words from our patients. Patient evaluation was done as primary and secondary end points.

## 2.11. Reinforcement of education

Another problem is the enforcement of the value of regular training sessions. As at the beginning of the process the best results achieved through academic stimulation are seen but usually diminish afterwards. To prevent attrition, a few days before the learning meeting, it may be helpful to inform the patients by their clinicians about the appointment by phone or text message.

## 2.12. Barriers to self-management

There are many obstacles to diabetes education and self-management. A few are human such as empowerment, education, inspiration, problem-solving skills, anxiety, gender, cognitive impairment, certain disorders, etc. and others are linked to the setting and community. Instructors must recognize some obstacles through open and trusting interaction with participants. Single face-to-face meetings can be more effective for this reason than group meetings. However, even when the education program is focused on group sessions, single lessons can be used chronologically. Cultural and linguistic discrepancies of minority groups represent significant barriers. It is essential for these group members to use special tools for adapting education.

## 2.13. Outcome indicators

### 2.13.1. Primary outcome

Normal Glycated Hemoglobin (HbA1c) was the primary goal. A Diabetes Control and Complications Trial (DCCT) method were used to measure glycated hemoglobin.

### 2.13.2. Clinical outcomes:

#### 2.13.2.1. Body weight:

Calibrated electronic scales were used to measure body weight. Of measuring height, a portable sonic machine was used. The value of Body mass index ( $\text{kg} / \text{m}^2$ ) was determined from measures of height and weight. The Tanita Body Fat Control measured the precision of body fat to  $\pm 0.5\%$ . The correct waist circumference assessment procedure has been used.

#### 2.13.2.2. Laboratory Results:

A complete lipid profile has been obtained. Blood pressure was measured using a digital blood pressure monitor by accepted methods. Current guideline studies also provided appropriate levels of blood lipids and blood pressure.

#### 2.13.2.3. Medication prescribed:

Drugs approved for diabetes treatment were tested every 14 months and compared at baseline with those prescribed. We defined the increase in medication by launching a new drug, increasing the dose of oral hypoglycemic drugs or use of insulin. However, a decrease of medication was described as a decrease in oral hypoglycemic drug type, quantity or the number of insulin units administered.

### 2.13.3. Lifestyle

The outcomes of lifestyle were evaluated regularly, 6 months, 12 months and 24 months. To what degree we were effective for encouraging, improving adaptation and strengthening family relationships of our patients. How many occasions have they been through periods of hopelessness and despair after the end of the study? To what extent we made our patient believe in self-efficacy and have a positive outlook on life? To what extent did our patients build a strong favorable doctor-patient interaction? And become more effective in coping with actions and had a better health-related quality of life with a favorable impact on their life. Variables of socialization, particularly skills for problem-solving and self-efficacy. Mental well-being. Identify and encourage personal goals and habits to accomplish self-determined objectives. How to build trust in an interpersonal relationship.

### 2.13.4. Psychological

We used Net promoter score, SDC score, and patient words through customer satisfaction surveys. Assessment of pre- and post-intervention patients 'self-esteem and psychosocial status. We evaluated the degree to which the educational sessions render our patients feel empowerment, emotional adjustment, and the real quality of life changes. How they adopt new challenges, essential survival skills. The extent to which they become fully consistent with a healthy, great life with social and psychological concerns.

### 2.13.5. Assessment of patient satisfaction (SDC score)

Collection of quantitative and qualitative data was carried out sequentially by face-to-face interviews. The interviews were conducted by the primary investigators who were not involved in patient care. Obtaining of informed consent preceded the interviews. During the first part of the interview a validated Likert-type questionnaire exploring different dimensions of patient satisfaction was administered by the interviewers. This was followed by a structured interview with open-ended questions exploring the same areas of patient satisfaction included in the questionnaire. All the responses were recorded in writing.

The four-point Likert type questionnaire employed has been developed and validated for use in Greek hospitals and it has exhibited satisfactory psychometric properties. It involves six dimensions of patient satisfaction with the care delivered and 29 items, 18 of which are directly related to the nursing staff, and 11 to the hospital environment. The six dimensions are: (a) technical aspect of care-response to patients' demands (10 items), (b) delivery of information and patient education (4 items), (c) interpersonal relationships and availability of nurses (4 items), (d) maintenance of a restful atmosphere (2 items), (e) cleanliness (3 items), (f) and hospital meals (6 items). At the end of the scale there are three general questions on overall satisfaction, the willingness of patients to be taken care of by the same staff in the future, as well as their intentions to recommend the specific nurses to others.

#### 2.14. Statistical analysis

The action program and the personal appointment groups were attributed by evaluating the cohort by time interface term from frequent measurement analysis of variability with Greenhouse-Geisser sphericity adjustment, taking the primary outcome of HbA1c and analyzing others as developing a hypothesis. With Microsoft Windows version 11.0 (SPSS Inc., Chicago, Illinois, United States), Stata version Nine (Stata Corp, Baton rouge, TX, USA) was used. If appropriate, the CONSORT claim was adhered to and as far as possible an attempt to examine was carried out.

Based on the t-test and chi-square test, we analyzed differences among groups. An analysis of the intention to treat, along with all other individuals involved, was carried out. Differences from baseline assessment were evaluated using multiple variability measurement methods to determine the discrepancies between self-care behaviors and HbA1c in the same group, pre and post-intervention. Pearson or Spearman rho correlations have been used to examine the relationships between data. Multiple regressions have been used to identify glycemic control predictors.

### 3. RESULTS

The two groups studied according to the type of health education model were observed to be homogeneous in terms of age, DM duration, and gender. The base-line clinical characteristics of the two groups, adherence to medication, distribution of morbidity, adherence to diet, and chronic complications are shown in Table 1. Demographic characteristics of randomized patients were similar between groups; significant differences were not observed between the groups (Table 1). The ANOVA analysis showed significant differences, before, during and after implementation of the program, in terms of Hb1AC, BP and LDL.

**Table 1**

Demo- graphic characteristics of randomized patients

Demographic Characteristics (baseline)		Cases (n=702)	Control (n = 489)	P value
		Mean (SD)	Number (%)	
Age (years)		39.7 ( $\pm$ 5.4)	52.6 (13.2)	0.76
Gender				
	Male	309 (44)	298 (43.8-56.5)	
	Female	393 (56)	200 (40.3-57.5)	0.57
Nationality				
	Saudi	611 (87)	40 (36.3-44.7)	0.76
	Yemeni	23 (3.2)	30 (28.8-31.4)	0.57
	India	18 (2.5)	20 (17.7-24.1)	0.88
	Egypt	13 (1.8)	52 (49.2-56.0)	0.26
	Syrian	11 (1.5)	64(60.3-69.5)	0.89
	Jordan	10 (1.4)	9 (6.5-13.1)	0.24
	Philippines	9 (1.2)	5 (3.1-7.9)	0.53
	Sudan	7 (0.9)	23 (19.1-27.5)	0.27
Education				
	Never	13 (1.8)	9 (6.5-13.1)	0.26
	Primary	56 (7.9)	5 (3.1-7.9)	0.46
	Secondary	114 (16.2)	23(19.1-27.5)	0.25
	College	344 (49)	51 (45.7-56.9)	0.44
	Tertiary	175 (24.9)	10 (7.3-14.3)	0.12

Marital status				
	Single	211 (30)	195 (62.6)	0.53
	Married	491 (70)	131 (9.5)	0.56
Occupation				
	Office	205 (29.2)	61(19.5)	0.87
	Factory	129 (18.3)	141(15.9)	0.52
	Fieldwork	105 (14.9)	84.0 (16.0)	0.44
	Housewife	102 (14.5)	26 (6.2)	0.58
	Professional	91 (12.9)	19(14.1–24.3)	0.18
	Retired	70 (9.9)	10 (6.9–13.9)	0.12
Duration of diabetes (years)		16.8 ( $\pm$ 4.3)	11.1 (8.8)	0.88
Treatment mode				
	Oral drug*	34 (4.8)	40 (36.3–44.7)	0.27
	Insulin	378 (53.8)	30 (28.8–31.4)	0.24
	Combined treatment	290 (41.3)	20 (17.7–24.1)	0.40
Body weight (kg)		88.7 ( $\pm$ 7.1)	52 (49.2–56.0)	0.31
Body mass index		26.7 ( $\pm$ 4.6)	26.6 (6.2)	0.58

702 potentially eligible patients sought enrollment and achievement of enrollment and were referred to a comprehensive model of clinical care. Demographic and socio-cultural characteristics are mentioned in terms of age, length of T1DM and sex. The specific health features, compliance to treatment, distribution of morbidity, commitment to diet, and medical risks as seen in Table 1.

The systematic model of health education resulted in favorable variations in HbA1c, LDL cholesterol and SBP ( $P < 0.05$ ); statistically significant differences were observed during the study (Figure 1, Table 2). The non-adjusted effect of the systematic health education model on parameter changes was higher for LDL, HbA1c, and SBP; this showed significant differences during the study ( $P < 0.05$ ). After an updated study, the HbA1c decreased by 0.67 per cent ( $P < 0.01$ ) in the systemic model of health education. In comparison, SBP decreased by 10.83 mmHg ( $P < 0.01$ ) and the amount of DBP, HDL and total cholesterol decreased significantly and did not important. (Figure 2, 3) conventional model achieve an improvement in all control criteria, but statistically significant differences were not observed (Table 2).

**Table 2:** Mean values (SD) of basal and final parameters

	<b>SHEM (n = 702)</b>	<b>Control (n = 489)</b>	<b>Unadjusted effect (95% CI)</b>	<b>Adjusted effect (95% CI)</b>
HbA1c (%)				
Basal	7.86 (1.2)	8.15 (1.5)		
Final	6.91 (0.7)	7.78 (1.3)		
Change	-0.95 (0.4)	-0.38 (0.6)	-0.87 (-0.01 to 1.7)	-0.67 (-0.97 to -0.36)
P value	0.03	0.57	0.047	<0.01
Total cholesterol (mg/dl)				
Basal	212.4 (64.9)	195.6 (62.6)		
Final	204.5 (68.6)	182.2 (60.1)		
Change	-7.91 (27)	-13.50 (25)	-22.3 (-32.2 to 76.9)	-6.7 (-15.1 to 28.5)
P value	0.77	0.60	0.41	0.53
LDL cholesterol (mg/dl)				
Basal	128.8 (9.6)	131.2 (9.5)		
Final	113.8 (14.8)	124.8 (9.2)		
Change	-15.1 (5.1)	-6.33 (3.8)	-11.1 (0.66 to 21.5)	-9.6 (-19.0 to -1.93)
P value	<0.01	0.11	0.04	0.046
HDL cholesterol (mg/dl)				
Basal	62.3 (15.9)	61.2 (19.5)		

Final	64.1 (13.1)	65.8 (18.1)		
Change	1.8 (5.9)	4.58 (7.6)	1.67 (-11.7 to 15.0)	2.52 (10.2 to 5.2)
<i>P</i> value	0.77	0.56	0.80	0.51
SBP (mmHg)				
Basal	137.5 (15.4)	141.6 (15.9)		
Final	125.0 (8.26)	138.4 (14.1)		
Change	-12.5 (5.1)	-3.25 (6.1)	-13.4 (-3.6 to -23.2)	-10.83 (-16.3 to -5.34)
<i>P</i> value	0.02	0.601	<0.01	<0.01
DBP (mmHg)				
Basal	89.0 (14.9)	84.0 (16.0)		
Final	85.8 (12.4)	82.7 (13.8)		
Change	-3.25 (5.6)	-1.33 (6.1)	-3.1 (-14.2 to 8.0)	-1.01 (-3.98 to 1.95)
<i>P</i> value	0.57	0.83	0.57	0.48
BMI (kg/m <sup>2</sup> )				
Basal	25.33 (4.5)	26.58 (6.2)		
Final	24.67 (4.3)	25.58 (5.7)		
Change	-0.67 (1.8)	-1.00 (2.4)	-0.92 (-3.4 to 5.2)	-0.23(-0.6 to 1.1)
<i>P</i> value	0.71	0.69	0.66	0.57

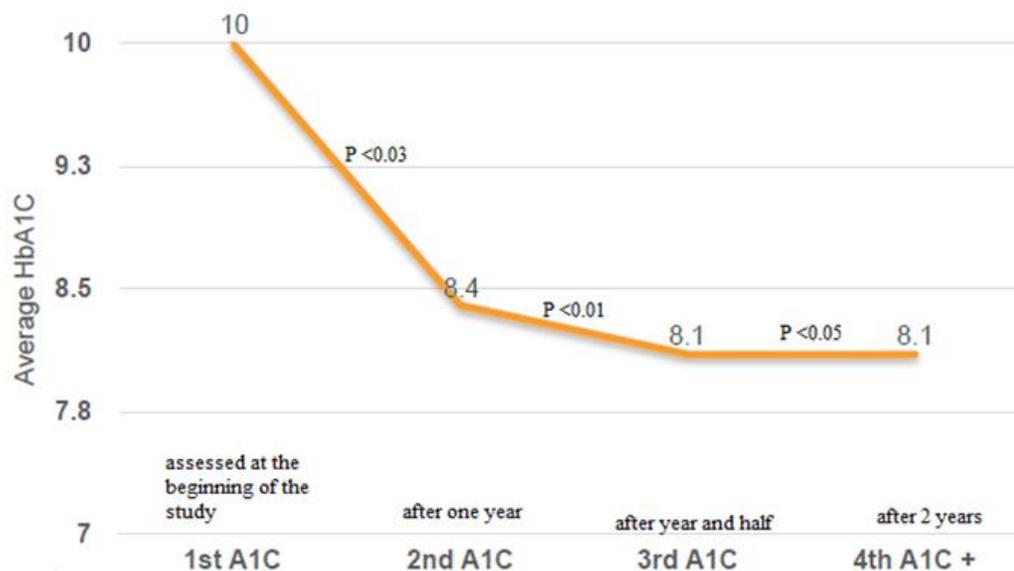


Figure 1: Glycemic improvement in all SDCs. 54% of SDC patients have HbA1c <8%

The BMI did not change substantially during the study and the adjusted effect of the systematic health education model was -0.23 (Table 2). Though, after 2 years of follow-up, the systematic health education model demonstrated efficacy in the percentage of patients targeted for cardiovascular risk factors: LDL cholesterol < 100 mg / dl ( $P = 0.02$ ), HbA1c < 7% ( $P < 0.01$ ), BP regulation (< 130/80 mmHg) ( $P = 0.03$ ), SBP < 130 mmHg ( $P = 0.03$ ), and global monitoring (metabolic and BP) ( $P < 0.01$ ). However, it was not important for the parameters DBP < 80 mmHg and BMI < 25 kg / m<sup>2</sup> (Table 3). Although, after two years in follow-up, the comprehensive model of health education proved stronger than the traditional percentage of subjects, the target for cardiovascular risk factors: LDL cholesterol < 100 mg/dl ( $P = 0.02$ ), HbA1c < 7% ( $P < 0.01$ ), BP control (< 130/80 mmHg) ( $P = 0.03$ ), SBP < 130 mmHg ( $P = 0.03$ ), and global control (metabolic and BP) ( $P < 0.01$ ). Nevertheless, it was not significant for the criteria DBP < 80 mmHg and BMI < 25 kg/m<sup>2</sup> (Table 3).

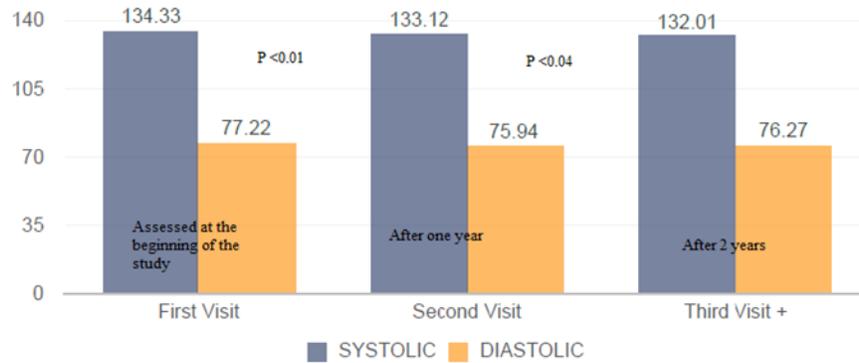


Figure 2: Average blood pressure. 56% of SDC patients on ARBs or ACE

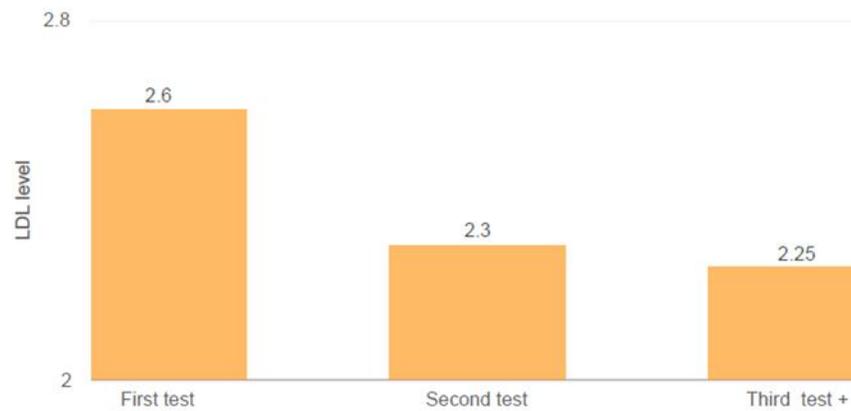


Figure 3: LDL improvement. 71% of SDC patients are on statin therapy

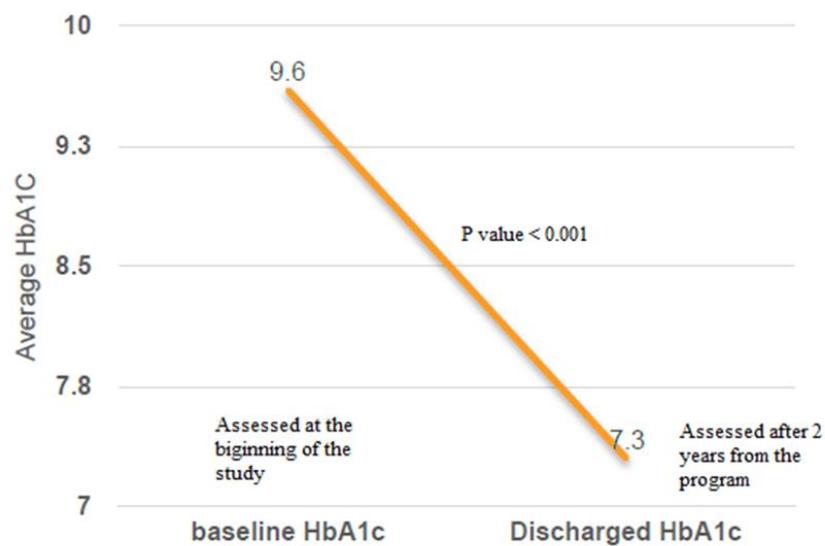


Figure 4: Discharged patients. 27% of SDC patients were discharged with on target A1C

**Table 3** baseline clinical characteristics of participants in comparison with 2 years after

	Base line characteristics	2 years after	%change	SE	95% CI	t-statistic	Difference	P-value
Exercise (hours/week)	2 (0.3)	5 (2.1)	+150	0.080	2.8429 to 3.1571	37.470	3.0	< 0.0001
Compliance with diet % (95%CI)	40.5 (36.3-44.7)	75.5 (70.4-80.2)	+87.5	0.253	34.5039 to 35.4961	138.393	35.0	< 0.0001
Self-control % (95%CI)	33.5 (31.8-35.2)	66.1 (61.4-70.3)	+100	0.253	32.1039 to 33.0961	128.903	32.6	< 0.0001
Foot care % (95%CI)	23.1 (19.2-27.3)	59.3 (55.7-66.5)	+156	0.253	35.7039 to 36.6961	143.138	36.2	< 0.0001
Therapeutic compliance % (95%CI)	49.3 (45.4-53.5)	88.5 (85.9-91.5)	+79.5	0.272	38.6661 to 39.7339	144.030	39.2	< 0.0001
HbA1c (%)	9.9 (2.1)	7.9 (1.1)	-25.3	0.136	-2.2669 to -1.7331	-14.697	-2.0	< 0.0001
LDL cholesterol (mg/dl)	2.59 (0.9)	2.07 (0.8)	-25.1	0.056	-0.6301 to -0.4099	-9.268	-0.52	< 0.0001
Systolic blood pressure (mmHg)	134.3 (18.2)	129 (15.5)	-4.1	0.514	-6.3078 to -4.2922	-10.316	-5.3	< 0.0001
Diastolic blood pressure (mmHg)	77.22 (10.5)	75.1 (8.1)	-2.79	0.325	-2.7369 to -1.4631	-6.468	-2.1	< 0.0001
Body Mass Index (Kg/m <sup>2</sup> )	32.3 (2.6)	27.2 (3.4)	-18.75	0.189	-5.4702 to -4.7298	-27.025	-5.1	< 0.0001

96.7% of our patients were completely satisfied by what they have achieved through this project. The average HbA1C become less than eight in 54% of patients. Patients with HbA1C 8-9%, BP <140/80, and LDL <3.36 mmol/l, were 46%, 51% and 79% respectively. Mean blood pressure; the number of patients in 56% was 132/77. The mean LDL level of 71 %of participants was 2.25. 27% of patients had average discharged HbA1c of 7.3. Net promotor score of SDC was 85%, were promotors, passives and detractors were 87.8%, 9.5% and 2.8% respectively. P value <0.05 (Tables 4 &7, Figure 4)

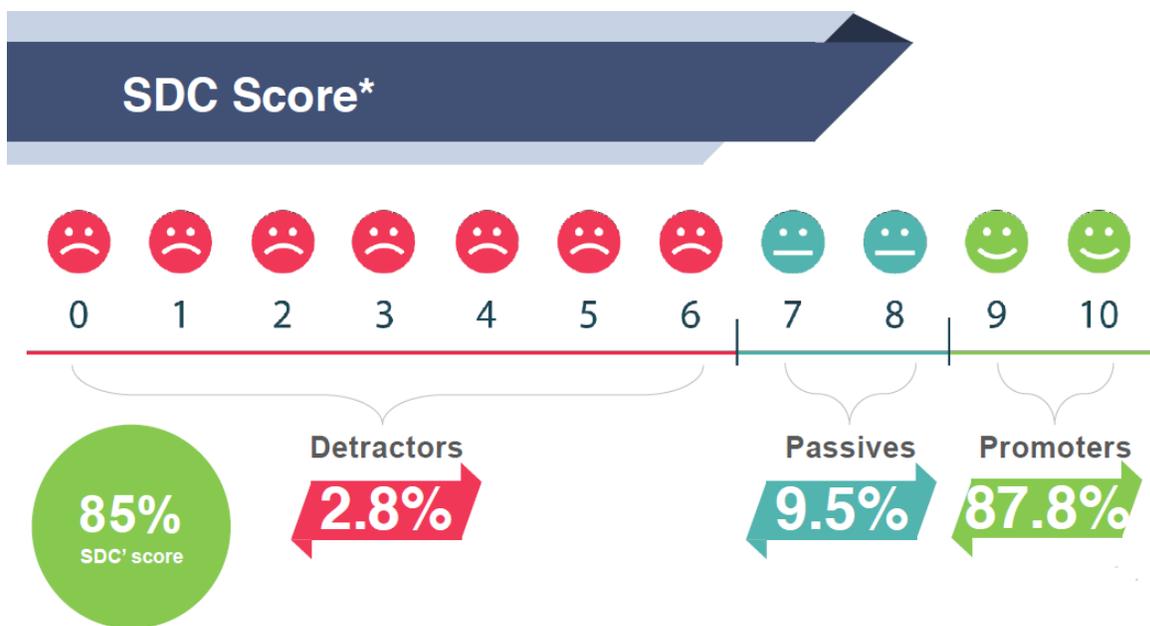
**Table 4:** Patient satisfaction survey

Please specify your level of satisfaction with the following points:	Satisfied	Neutral	Dissatisfied	P value
1. Easy registration process	95%	3.3%	1.7%	
2. care of staff at the registration area	96.7%	1.7%	1.7%	
3. Waiting time in the clinic.	87.8%	6.1%	6.1%	
4. Kindness and care of the medical staff.	97.2%	1.7%	1.2%	
5. Explanation provided by the medical team about your health status.	95.5%	3.9%	0.6%	
6. The medical team's attention about your questions and concerns.	96.2%	2.2%	1.7 %	
7. your involvement in treatment decisions	95.5%	3.9%	0.6%	
8. Instructions which given by medical team regarding your health status	96.1%	1.1%	2.8%	<0.05
9. Your trust in medical team	96.6%	2.2%	1.2%	
10. The time the medical team spent with you	96.1%	2.2%	1.7%	
11. The medical team's response to your needs	95.5%	1.7%	2.8%	
12. Patient confidentiality	97.3%	2.2%	0.6%	
13. The medical team cooperation in the provision of care for you	96.7%	1.7%	1.7%	
14. The possibility of recommending SDC to others	96.7%	2.8%	0.6%	
15. Your overall evaluation of the care you received at SDC.	96.7%	1.7%	1.7%	

#### 4. DISCUSSION

This prospective, study is considered as a strategic integrated project. It was established, as a clinical project including its infrastructure, man power, material, budget, policies and procedures. This project was established for full integrated management of diabetic patients (Labate, 2013). Our care rendered to the patients has been reflected on their outcomes (Alanzi, 2016). Therapy together with health education through social media, what-Sapp groups and focus group discussion together with individual face to face interviews, had a good impact on our patients (Cooper & Kar, 2014). It was an effective intervention that had an observed effect on patients' outcomes (Zowawi et al., 2015). We evaluated our patients, pre and post intervention to see the change in some pre-specified variables (Figure 5). We noticed the change in their clinical statuses, anthropometric measures, laboratory results, psychosocial lives, lifestyles, and quality of lives.

702 patients is a good number to start a prospective study, with zero percent attrition or drop-outs. Indeed, building up of good friendly relationships, trust and rapport with your patients from the beginning, is better than insulin. Health education, patient motivation, self-management knowledge, skills, is useful in improving metabolic control. This will reduce the patient and family costs in secondary and tertiary management. Moreover, this improvement observed and maintained at 24 months.



**Figure 5:** SDC score and NET score of Evaluation program

**Table 6** The subjective experience of impact on life from efforts of health behaviour change as evaluated by participants in a life style follow-up study, per cent and 95% CI

Behavioral effort	Negative impact	Indifferent	Positive impact
Increase exercise	7 (3-15)	35 (25-45)	656 (647-669)
Attain lower cholesterol level	13 (7-22)	40 (30-51)	647 (636-656)
Reduce weight	19 (11-31)	36 (26-50)	643 (631-655)
Decrease salt intake	9 (4-17)	44 (33-56)	647 (636-656)
Quit smoking	26 (16-40)	27 (17-39)	646 (634-656)
Reduce stress	19 (6-33)	30 (17-46)	651 (636-667)

**Table 7** Distribution of patient satisfaction measures according to intervention group (IG) or conventional group, (CG) in NET promoter scores among patients (answers are dichotomized).

Statement	Intervention group	Disagree or uncertain	Agree	x2 p value
I have been satisfied with the care I have received.	IG	9	51	0.02*
	CG	1	52	
I find that my health has improved the last year	IG	23	35	0.20
	CG	27	25	
I found it unpleasant to be reminded of the risk of heart disease.	IG	24	36	0.14
	CG	29	25	
I am satisfied with my own efforts for improving health.	IG	21	36	0.01
	CG	32	22	

\*Fisher's exact test

There is no longer a need to justify the value of patient education: education is part of a patient-centered humanistic therapeutic approach; it enables patients to be actively involved in their own recovery with the goal of increasing the quality of life and adherence with medication, as well as minimizing possible complications. Thus, our healthcare professionals are therefore educating, advising, preparing, engaging with, inspire and support physicians in disease follow-up which takes long time (Petrovski, 2015).

Our study showed a portrayal in cognitive and behavioral therapy and inspirational interviews as a main contributor to clinical patient education, which occurs in an environment of understanding and emotions, correlated with several psycho-educational strategies. This paradigm had an obvious effect on clinical and laboratory outcomes, as well as, the psychological aspect and the quality of life. Many studies have shown that diabetic patients' education is a patient-centered humanitarian strategy that encourages clinicians to be protagonists in their own care, improve their well-being, and reduce the likelihood of possible complications (Chen et al., 2015).

Group preparation for patient education must start as soon as a training need is defined through diagnosis (Hammami, 1994). Early diagnosis and education offers time to identify and overcome challenges, creates constructive practice opportunities and promotes the ability to solve and deal with issues and problems. Our aim was to provide the patient (or healthcare provider) with time to perform survival skills and self-management (Haynes, 1979).

Our key nutritional targets were to improve glycemic control, offer appropriate nutrients and calories to satisfy metabolic needs, and establish a follow-up treatment life-plan. Some of the problems that may hinder the accomplishment of these targets in our facilities include: meal time planning and need-based modifications; in case of surgery laboratory testing, and procedures. When the patients lose their appetite or loss of ability of eating after drug administration or after acute diseases, glycemic control becomes very difficult (Buse, 2011). Other problems such as; inconsistent consumption of sugar, nutrition that is not addressed in the diet plan, inefficient food distribution arrangement with point of care sugar level monitoring and insulin treatment, lack of principles understanding by doctors, patients and families of the existing values of diabetes health, variability of requirements of insulin among patients, either on enteral or parenteral nutrition, decreased exercise and sedentary life (Rohlfing et al., 2002).

We met maximum glycemic targets for our patients. To achieve optimal glycemic control and glycemic targets thus reducing hypoglycemia, successful insulin therapy needs to be understood and used. Recent studies have highlighted the significance of preventing hypoglycemia to minimize risk, but avoiding hyperglycemia is equally as important (Stein, 2005).

It is advised to develop guidelines, order sets, and glycemic goals by an interdisciplinary group of administrative support (Barreira, 2012). Developing and enforcing hospital-wide protocols and uniform insulin order sets will assist patients in choosing the right insulin protocol while preventing adverse events (Vischer, 2016). The use of a responsive "sliding scale" should be discontinued, and the standard of care should be therapeutic insulin schemes including basal, postprandial and corrective insulin (Rocks, 2016).

Throughout tandem with a patient-centered strategy, the diabetes educator can also promote the production and use of structured insulin order sets and procedures to avoid hypoglycemic episodes, achieve optimal performance, and mitigate harm capacity (Merkouris, 2002). The diabetes educator should also promote the development and use of protocols to manage and control hypoglycemia and make recommendations for improvement (Clement, 2010).

When indicated for all patients with hyperglycemia or at high risk of hyperglycemia, our clinicians followed them through routine check of glycated hemoglobin and daily glucose monitoring. This includes diagnosis of cases with diabetes as well as patients received high-dose corticosteroids, immune suppressants, and intravenous and oral nutrition. After blood transfusions or with a record of uncontrolled glucose levels, the glycated hemoglobin level may not be accurate, or if there are hemoglobinopathies in case of dialysis patients or those receiving chemotherapy. In pediatric, obstetric, and emergency patients, point-of-care ketone screening should be recommended (Pétre, 2017).

With this objective in mind, the diabetes educator may engage in the foregoing educational activities: evaluating the knowledge and skills of patients having diabetes; improving self-management skills; providing training in a variety of contexts, including staff induction, medical areas and big rounds; designing curricula for sharing with other team leaders; using a variety of educational tools; for example; case studies, workshops of self-learning, journal societies, templates of survival skills and flash cards to meet the needs and preferences of all environments and learners (Beck, 2017).

In our study, every patient had a good experience and take-home message after two years of hard work. After a countless episodes of depression, suicidal attempts, anxiety, upset, loss of hope, loss of self-esteem, loss of self-confidence and feelings of uselessness in life. Most of our patients, if not all of them, become full of hope and enthusiasm. Some of them become body builders; others win medals in championships of biking and mountain climbing, and many other examples, no space to mention (Riemenschneider, 2018).

For present, however, it is important to maintain the education systems while at the same time continuing to investigate the effects of social media in order to identify certain categories of patients who may prosper from this tool. Regular medical interaction

may be more relevant to patients and families modifying their insulin protocol, promoting self-management and encouragement. It will also be very beneficial in pre-gestational diabetes, patients with constant subcutaneous insulin infusion and patients with a high risk of developing serious acute complications correlated with other therapies (corticosteroids). In order to know the impact on health care system and leadership performance to patients with chronic disorders, it is also important to identify the implications of education on the interaction of primary and secondary management (Funnell, 2010).

To summarize, using an immersive tele-education system embedded into an intense face-to-face follow-up, produces significant changes in metabolic profile, quality of life, and self-care compared to traditional drug prescribing and reconciliation follow-up. Improving contact services, though, is important to provide effective cost reductions to the healthcare and diabetes community.

## 5. CONCLUSION

As a consequence of all the variables listed above, it can be inferred that the comprehensive health education approach is a valuable tool for the treatment of T1DM, as it leads to a decrease in HbA1c, LDL cholesterol and SBP rates, as well as to that conformity with the regulation criterion, except for DBP and BMI. Since health education will result in cost reductions and better results, Medicare and other payers would be protected by health education. In order to address this scarcity, DM-care educators will provide comprehensive health education to raise understanding of the seriousness of diabetes, its risk factors, and approaches to avoid diabetes and its complications in at-risk populations.

### Authors' Contributions

Yasser Sabr crafted a research plan and prepared a report. He checked out the manuscript. He contributed to the writing of the text, read and support the final document. Team members of the diabetes clinic and medicine as well as endocrinology department shared and participated equally as a coordinated team in the steps of the project as a part from their daily routine work and involved as well in the conception and design of the work, data collection, data analysis, interpretation, drafting the article, critical revision of the article, final approval of the version to be published. A large, multicenter group has conducted the work, the direct responsibility for the manuscript was referred to a single author. However, these individuals did not fully meet the criteria for authorship/contributorship defined above, so they were not added to author list. And there were no conflicts of interest among the team members about the consensus to make doctor Yasser Sabr the corresponding and single author.

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### Informed consent

Informed consent was obtained from all participants.

### Ethical Approval

The study was approved by the Medical Ethics Committee of King Saud University (ethical approval code: 381/kj/981-23).

### Conflicts of Interest

The authors declare that they have no conflicts of interest.

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### Data availability

All data associated with this study are present in the paper.

### Peer-review

External peer-review was done through double-blind method.

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