

A Novel Diabetes Education Program to Improve Diabetes Knowledge, Awareness and Glycemic Control

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ABSTRACT

Diabetes self-management education (DSME), an integral part of diabetes management is delivered by trained educators in well-developed countries. Unfortunately, there is a dearth of an organized, concise and easy-to-deliver diabetes education module in India. The relationship between diabetes self-care and glycemic control has been studied extensively. The present review discusses an innovative diabetes self-education training module that can be easily reciprocated by others to benefit the larger population.

Keywords: Type 2 diabetes, diabetes self-management, patient education

Diabetes self-management education (DSME) is globally recognized as an integral part of diabetes management and, in most developed countries, is delivered by trained diabetes educators. Diabetes self-care includes a range of activities like self-monitoring of blood glucose, regular physical activity, balanced diet, adherence to medicine and foot care. The relationship between glycemic control and self-care has been documented extensively.¹⁻³ However, in India, it is still not considered as an integral part of diabetes management.

Khunti et al reported a Diabetes Education and Self-Management program for Ongoing, and Newly Diagnosed (DESMOND)⁴ patients. This program involved 13 primary care centers in the United Kingdom and imparted diabetes education within 12 weeks of diagnosis. In this program, diabetes self-care led to dramatic improvements. Another meta-analysis

of 31 studies showed that DSME reduced glycated hemoglobin (HbA1c) by 0.76% at immediate follow-up.⁵ A study included in the meta-analysis demonstrated interventions delivered face-to-face to be better when compared with telecommunication.⁶

There are limited studies on DSME in the Indian context.⁷ Diabetes awareness is limited in India. Almost 50% of the Indian population has undiagnosed diabetes.⁸ A controlled study, including 100 patients, has recently been reported from North India. Patients were offered diabetes education and leaflet at baseline and, at first, follow-up. At the end of the study, there was a significant improvement in knowledge, attitude, practices and glycemic control.⁸ The Prevention, Awareness, Counselling and Evaluation (PACE) project was done to increase awareness of diabetes in Chennai, Tamil Nadu.⁹

Shukla et al have evolved a DSME program whose impact has been assessed in 50 patients. The diabetes education course aims to empower participating individuals with skills and knowledge of diabetes education.¹⁰ The present article describes the diabetes education course and the methods used in administering the program so that it can be reciprocated by others benefitting a larger population.

TARGET AUDIENCE

The diabetes education program is targeted to all individuals with type 2 diabetes mellitus (T2DM) along with those involved in care of these patients. The course

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is aimed to be used by the clinicians, diabetes educators and people living with diabetes.

Training Module

The total duration of the course is 75 minutes, and it can be imparted to the learners in a single session. The trainers received a training to implement the program, over a period of 2 months. The trainers can deliver the training to a group of people. Diabetic educators may also conduct the course either through physicians or directly. Many pharmaceutical companies can also conduct programs for the patients. With the online portal, patients may also assess the program directly and get empowered.

Educational Module

The key areas covered under the course include introduction to diabetes, diet and exercise, acute complications, chronic complications, screening investigations, self-monitoring of blood glucose, insulin delivery and sick day rules. Table 1 provides the framework of the course.

Introduction to diabetes

Diabetes is defined by either an impairment of insulin production or its inability to function eventually leading to raised blood sugar levels. There are three types of diabetes – Type 1 diabetes mellitus (T1DM), T2DM and gestational diabetes (GD). T1DM usually starts in childhood and requires insulin from the onset of disease. T2DM usually starts in adulthood after the age of 25 years; however, it has been observed in obese children especially with a family history of diabetes. GD is detected for the first-time during pregnancy and increases the chances of T2DM later in life.

The risk factors of diabetes comprise of family history of diabetes, obesity, sedentary lifestyle, hypertension, dyslipidemia, history of diabetes during pregnancy or prediabetes.

Diabetes can be identified by common symptoms including excessive thirst, frequent urination, weight loss and early fatigue. In a large number of cases, there are no warning symptoms, hence diabetes goes undetected.

Doctors may interpret your blood glucose and HbA1c level to diagnose prediabetes or diabetes (Table 2).

Diet and diabetes

Various myths are prevalent about diet in diabetes, despite of diet being a crucial part of diabetes

Table 1. Description of the Educational Module on Type 2 Diabetes

Topic	Description
Introduction	Classification of diabetes, and how to identify diabetes risk.
Diet and diabetes	Understanding the immediate and long-term implications of balanced diet in managing diabetes.
Exercise	Importance of different forms of exercise in optimization of blood glucose levels and maintaining a healthy BMI.
Acute complications	Hypoglycemia and hyperglycemia, how to manage them and when to seek help
Chronic complications	Uncontrolled blood glucose and different chronic complications such as retinopathy, neuropathy, nephropathy, diabetic foot and cardiovascular diseases linked with it.
Screening and investigations needed	Investigations needed, their frequency and significance in screening complications related to diabetes.
Self-monitoring of blood glucose	The role of self-monitoring in effective management of blood glucose.
Insulin	Awareness about insulin use, allaying fears related to misconception about insulin.
Sick day rules	What to expect during sick days and what should be done.

Table 2. Interpretation of Blood Glucose Levels

Interpretation	Fasting blood glucose (FPG)	Postprandial blood glucose (PPBG)	HbA1c (%)	Random blood glucose
Normal	70-90 mg/dL	100-139 mg/dL	<5.7	
Prediabetes	100-126 mg/dL	140-200 mg/dL	5.7-6.5	
Diabetes	>126 mg/dL	>200 mg/dL	>6.5	>199 mg/dL with symptoms

management. The diet for diabetes needs to be a healthy diet. The three main components of the diet are carbohydrates, proteins, fats and minor components like vitamins, minerals and fibers.

➤ **Carbohydrates:** Carbohydrates are the primary source of energy in our body. Wheat and rice are the primary sources of carbohydrates, and it is also

present in vegetables and fruits. Carbohydrates should form 50% to 55% of total caloric intake with low glycemic index foods. The use of low glycemic index food prevents rapid rise of blood glucose. *Potatoes and rice are not restricted in individuals with diabetes but should be consumed in moderate amounts. Sugar-free tablets are not harmful; they make food palatable without any nutritive value.*

- **Proteins:** Meat, egg, milk, dry fruits and pulses are rich sources of protein in the diet. Proteins are needed for building the muscles and bones. Daily protein requirement is 0.8-1.0 g/kg/day or 15-20% of total caloric intake. Patients with renal failure should consult doctors for their dietary requirements, as protein intake may be reduced in these patients.
- **Fats:** Fats are an essential component of food and is available from oils, meat, dry fruits, milk, etc. Fats act as reserve store of energy and is also utilized in forming several hormones and enzymes. Typical diet should contain 20-25% of fats. There are three main types of dietary fats including saturated, polyunsaturated and monosaturated. Equal proportion of all types of fats should be included in the diet. People with high cholesterol should reduce fat intake in their diet.
- **Fibers:** Fibers are essential component of diet, particularly in individuals with diabetes. It helps in delaying the absorption of carbohydrates, thus preventing a quick rise in blood sugar level. The recommended daily intake of fiber should be approximately 20-35 g.
- **Minerals and vitamins:** Minerals and vitamins are usually present in a normal healthy diet; hence, they are not required in the form of extra supplements unless there is a deficiency. All green vegetables and fruits are rich sources of vitamins and minerals. It is advised that vegetarian people on metformin should take vitamin B12 as a supplement.

Exercise and diabetes

Exercise constitutes an integral part of the lifestyle management of diabetes. People with diabetes should be provided adequate training by trained physiotherapists and physical trainer.

Precautions should be taken before exercise, if your blood glucose is too high (>250 mg/dL) or too low (<90 mg/dL), if you are pregnant, if you have any cardiac disease or if there are any signs of nephropathy or retinopathy. Doctor should be consulted in all such

cases. It is recommended to wear good-fitting footwear and carry an ID card depicting diabetes (and other diseases) and phone numbers to be contacted in case of an emergency.

- **Aerobic exercises:** Simplest form of exercise, such as brisk walking, cycling, dancing and swimming. The recommendation is to do exercise at least 30 min/day, with a minimum of 5 days/week.
- **Anaerobic exercises:** Anaerobic exercises help in breaking down glucose for energy without using oxygen. Anaerobic exercises are of short duration with high intensity, to ensure energy is released within a short period, and oxygen demand surpasses the oxygen supply. Anaerobic exercises comprise of weight-bearing exercises like dumbbells, sprinting and push-ups. The recommendation is for doing anaerobic exercises 2 to 4 times a week and three sets for each muscle group.
- **Yoga and Pranayama:** Respiratory and postural exercises are recommended for 30 minutes every alternate day.

Acute complications

The two most critical acute complications of diabetes include hyperglycemia and hypoglycemia.

- **Hyperglycemia:** Many times, high blood sugars may go unnoticed. The symptoms include increased hunger and thirst, fatigue, dryness of mouth, lethargy, blurring of vision, itching in genitalia. To manage hyperglycemia, check blood glucose regularly, take proper diet, drink plenty of water and take medicines regularly. It is important to adhere to doctor's prescriptions.
- **Hypoglycemia:** Blood glucose level below 70 mg/dL is referred to as hypoglycemia. It commonly occurs due to a mismatch between food intake and insulin/oral medicine doses. The reasons for hypoglycemia include delay or skipping meals, unable to eat due to lack of appetite or illness, unplanned exercises or not measuring blood glucose regularly.

Chronic complications

Uncontrolled blood glucose affects almost all organs of the body. Table 3 describes the different chronic complications associated with T2DM.

Screening and investigations

Diabetes may affect almost all the organs, hence, patients with diabetes are recommended several investigations to screen for the optimal functioning of these organs. All the routine screening tests are intended to keep an

Table 3. Chronic Complications Associated with Type 2 Diabetes Mellitus

Complications	Organ involved	Causes	Manifestations	Screening & management	Risks involved
Retinopathy	Eye/Retina	Occurs in case of unmanaged long-term diabetes, in association with nephropathy and hypertension.	Blurring of vision, frequent changes in glasses; however, most have no problems.	Once a year examination of retina (fundus examination) is recommended. It can be prevented by optimal blood glucose and blood pressure management.	Four times high chances of blindness in individuals with diabetes compared with the general population.
Neuropathy			Pain and burning in lower limbs, constipation, dyspepsia, recurrent diarrhea, impotence, etc.	It can be prevented by managing blood glucose levels.	
Nephropathy	Kidney		Symptoms seen at much later stages.	Urine albumin to creatinine ratio, urine-R & M, S creatinine should be conducted annually. Can be managed by good blood sugar and blood pressure control.	
Heart diseases	Heart	Smoking, high cholesterol, uncontrolled blood pressure and overweight	Breathlessness and/or chest pain on walking, excessive fatigue, increased perspiration, choking of the throat, jaw pain, etc.	Sometimes, symptoms are minimal, but with strong suspicion. It can be prevented by consuming low-fat diet, regular physical activity, optimal blood glucose level, and blood glucose control. Cholesterol-lowering medications are also prescribed as a protective measure.	
Cerebrovascular disease or palsy	Brain	Uncontrolled blood pressure and diabetes.	Slurring of speech, weakness in one or more limbs, or one-half of the body and altered consciousness.		
Diabetic foot disease	Foot		Any signs of blister or wound on foot (redness, swelling, too cold or warm feet), presence of corn or thickening of the skin.	Foot examination once a year, check shoes daily for any nail or deformity, keep clean and dry feet.	

eye on the complications associated with T2DM. The first screening includes “**ABC**” of diabetes; **A** for A1c (defined as average of last 3 months glucose and should be under 7.0%), **B** for blood pressure which should be measured at every follow-up visit and target should be under 130/85 mmHg and **C** for cholesterol. In addition, other tests include serum creatinine (kidney function test), liver function test, annual fundus examination and ECG (heart function).

It is important to know the standard levels of these parameters to stay informed about the disease (Table 4).

Self-monitoring of blood glucose

Self-monitoring of blood glucose (SMBG) has assumed great significance in the management of T2DM. It is advisable not to monitor the blood glucose by symptoms but by SMBG. SMBG provides immediate information about the blood glucose level and through constant

Table 4. Optimal Levels of Blood Glucose, Blood Pressure and Lipid Profile

Parameter	Standard values
Blood glucose	Fasting – 80-130 mg/dL
	Postprandial – <180 mg/dL
	A1c – <7%
Blood pressure	Systolic – <130 mmHg
	Diastolic – <85 mmHg
Lipid profile	Total cholesterol – <180 mg/dL
	Low-density lipid – <70 mg/dL
	High-density lipid – >40 mg/dL (male); >50 mg/dL (female)
	Triglycerides – <150 mg/dL
	ECG – once a year

monitoring reduces the risk of diabetes-associated complications.

Need for SMBG

SMBG enables an individual with diabetes to track the effect of food, medicine, exercise and various stressors such as psychological or physical based on the blood glucose level.

Requirement for SMBG

For SMBG, an individual requires glucometer, glucose strips, needles and a logbook if the glucometer does not have a phone-based application to automatically log in data.

How to do SMBG?

Before conducting a self-test, the following steps should be carried out: 1) Wash your hands with soap and water, dry them; 2) Remove a glucometer strip and insert it into the glucometer; 3) Prick your finger at the side from the pricker (using a new needle for every prick); 4) Pour a drop of blood on the strip; 5) Wait for the blood glucose value to be displayed on the glucometer and 6) If not automatic, manually enter the blood glucose value in the logbook.

Frequency of blood glucose monitoring

Type 2 diabetes patients should check blood glucose once a week, 2 to 4 times. Type 1 diabetes patients should monitor daily, 4 to 6 times.

Interpreting the glucometer readings

The normal readings of the blood glucose are: 1) Fasting blood sugar 80-130 mg/dL (after 6-8 hours of sleep); 2) Two hours after meals 180 mg/dL and 3) Anytime blood sugar or random blood sugar <180 mg/dL.

It is important to note that the glucometer values are different from the laboratory values as the laboratory values use capillary blood while the laboratory uses venous blood. The lab values may be reduced by 10% to 15%.

Insulin

Several misconceptions are prevalent about insulin such as the insulin injection is the last resort treatment, it is addictive and it may have a negatively adverse effect on all body organs. On the contrary, insulin is important in T1DM patients. Hence, there is a need to bust these myths. When the oral antidiabetic medication is unable to optimize the blood glucose level, the patients may require insulin. During an emergency such as an infection, heart attack or surgery, insulin is required, and the patient returns to their regular treatment after they recover. Insulin has no adverse effect on the body; in fact the use of insulin leads to an overall improvement of blood glucose, allowing for organ protection. It is very important to consult the doctor, discuss the use of insulin and trust them about how to use insulin correctly.

Sick Day Management

Several triggers such as fever, injury, heart attack, stroke or emotional turmoil may lead to an increase in blood glucose levels, while in some cases such as diarrhea and vomiting, blood glucose levels may reduce. People with diabetes have several misinformations about sick days and its effect on blood glucose level.

To manage diabetes during sick days, regular blood sugar monitoring is needed (6 times or more), continue diabetes medicines or insulin, do not stop long-acting insulin such as glargine insulin, depending upon pre-meal blood sugar values change the doses of short-acting insulin. Individuals with diabetes on tablets should adhere to meals or try to eat something, at frequent intervals. If the blood sugar is persistently high (over 300 mg/dL) - consult your doctor and may need transition to insulin treatment. Another common problem during sick day is dehydration, so ensure an adequate intake of low-calorie, low-glycemic index fluids. Along with dehydration, diabetes may also be marked with polyuria. It is important to measure urine ketones, if blood sugar level is >300 mg/dL. Medical assistance is immediately required in case of positive urine ketones, diarrhea and vomiting for more than 12 hours, fever >24 hours, sick looking, not sure about hypoglycemia or ketoacidosis, blood sugar is <90 mg/dL despite oral glucose solution administered twice and blood sugar >250 mg/dL in last 12 hours.

CONCLUSION

To the best of our knowledge, this is the first organized Diabetes Education Program in the country. The authors have attempted to cover all the relevant and useful aspects to deal with diabetes. The main challenge was to conceptualize and develop a comprehensive program. Going ahead, the PowerPoint version is under planning to be put up on the website (www.spadonline.com) for broader coverage. The authors have also planned in the future to use an edited recording in the training program.

The authors anticipate the course to have a vast potential in successfully training individuals with diabetes and diabetes educators. The program is intended to be available to everyone; hence, it is anticipated to be cost-effective and useful. The authors hope that this program will go a big way in bridging the gap in diabetes awareness and help people with T2DM.

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Author Contribution

RS, DY, SS and AB conceptualized and planned the study. RS, NA and MG did literature review and drafted the initial manuscript. RS, BG and AB critically reviewed the manuscript and would act as guarantor of the paper.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Ethical Approval

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