

# The Impact of Diabetes Education on Improving Patient Outcomes

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## ABSTRACT

**Background:** Diabetes education provided by certified diabetes educators (CDEs) can help improve the lives of patients with diabetes mellitus (DM). With morbidity, mortality, and medical costs of increasing concern, diabetes educators must provide patients and primary caregivers with the tools to improve their DM and the motivation and understanding to help them meet their goals.

**Objective:** The goal of this article was to determine the effectiveness of education provided by CDEs in an American Diabetes Association–recognized outpatient program for adults.

**Methods:** Review of the literature from 2003 to 2006 was undertaken using the search terms *diabetes education, efficacy of lifestyle education, A1C reduction, and certified diabetes educators*. Landmark studies such as the Diabetes Control and Complications Trial, the United Kingdom Prospective Diabetes Study, and the Diabetes Prevention Program were also cited. The staff at Saint Joseph's Hospital, Center for Diabetes Care, developed a questionnaire to ascertain how patients were managing key indicators related to DM. Data were gathered on patients who had both an initial visit (IV) during 2003 and 2004 and a follow-up visit (FUV) that typically took place 4.5 months later. During their IV, patients were assessed, provided with basic information, and set goals. They then participated in 2 subsequent classes within the next few months on DM self-management and returned for the FUV. The questionnaire was completed at both the IV and FUV. The answers were blinded. Data were examined to determine if diabetes education provided by CDEs changed patient behaviors and decreased glycosylated hemoglobin (A1C) values.

**Results:** A total of 501 patients had an IV and an FUV. Between visits, mean A1C level decreased significantly from 7.9% to 6.7%; mean weight decreased significantly from 198.6 to 196.0 lb; systolic blood pressure decreased from 132.8 to 131.5 mm Hg and diastolic blood pressure decreased from 79.4 to 77.1 mm Hg; medication adherence increased from 5% to 21% for 4 classes of medication; exercise increased from 58% (284) to 80% (403) of patients; and self-monitoring of blood glucose levels increased from 53% (260) to 98% (476) of patients. More than half of the 89% (446) of patients who set goals at the IV met their goals.

**Conclusion:** The diabetes education provided by CDEs helped patients adopt the healthier lifestyle behaviors needed to control their DM and to reduce their A1C levels. (*Insulin*. 2007;2:24–30) Copyright © 2007 Excerpta Medica, Inc.

**Key words:** diabetes mellitus, diabetes education, certified diabetes educators, outpatient diabetes program, reduced A1C.

## INTRODUCTION

Saint Joseph's Hospital, Center for Diabetes Care, Atlanta, Georgia, is staffed by a team of certified diabetes educators (CDEs) who are registered nurses or registered dietitians. Under the guidance of a medical director, the team offers an American Diabetes Association (ADA)-recognized program that incorporates knowledge, skills training, and behavior modification to help patients with diabetes mellitus (DM) and their families adopt healthier lifestyle behaviors that may translate into better control of DM and improve quality of life.

Poorly controlled DM is associated with increased morbidity, mortality, and medical costs.<sup>1</sup> One key to controlling DM is diabetes education.<sup>2</sup> Review of the literature from 2003 to 2006 using the search terms *diabetes education, efficacy of lifestyle education, A1C reduction, and certified diabetes educators*, as well as landmark studies such as the Diabetes Control and Complications Trial (DCCT), the United Kingdom Pro-

spective Diabetes Study (UKPDS), and the Diabetes Prevention Program (DPP) reveal the value of diabetes education, indicating that it provides patients with information they need to manage their disease.<sup>3–5</sup> Intensive treatment of DM has been the recommended standard since the DCCT<sup>6</sup> and the UKPDS.<sup>7</sup> The findings from these studies have helped many patients prevent complications from uncontrolled hyperglycemia.

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Diabetes educators work in many settings and with different resources—from hospital-based programs to outpatient programs in pharmacies and stores.<sup>8,9</sup> The DPP<sup>10</sup> offers an excellent example of the effects of education and health guid-

ance on DM prevention. The research question is: Is there any evidence that diabetes education provided by CDEs improves patient outcomes? The purpose of this study was to determine the effectiveness of education provided by CDEs at this ADA-recognized outpatient program for adults.

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## MATERIALS AND METHODS

This study used a nonexperimental, descriptive, longitudinal design and included physician-referred patients who attended the outpatient diabetes education program at Saint Joseph's Hospital, Center for Diabetes Care, between 2003 and 2004. Patients were referred to the center because physicians frequently do not have time for diabetes education during office visits.<sup>11</sup>

In an attempt to measure the program's effectiveness, staff at the center began collecting patient data in 1997 using a set of questions called the Registry (**Appendix**). Patients' answers to the Registry were not part of their charts; the answers were entered into a computerized system (Patient Analysis & Tracking System, version 4.10.20, Axis Clinical Software, Inc., Portland, Oregon) to create a database.

At their initial visit (IV) to the center, patients were assessed regarding understanding of DM and the effects of food, activity, and medications on their blood glucose (BG) levels; ability to test their BG levels; ability to take medications correctly; ability to set effective goals; and knowledge of current self-care practices. The Registry was completed for or by each patient during the IV.

The team then entered patients' answers to the Registry into the database. Patients' glycosylated hemoglobin (A1C) values were obtained either from current laboratory tests (<3 months) or measured during the IV. Blood pressure, weight, and height were also obtained during the IV and entered into the database. These same measurements were made at the follow-up visit (FUV) and entered into the database. Patients without BG monitors were given new monitors and instructed on their use. Special emphasis was given to monitoring BG levels. Patients were taught not only the proper frequency of BG monitoring for their needs, but to recognize patterns in their BG levels. They were also provided verbal and printed information on how to reduce their A1C levels.<sup>12</sup>

Patients were given log sheets, asked to record their BG values, instructed how to treat hypoglycemia and hyperglycemia, and asked to evaluate their BG levels based on insulin needs, activity levels, or food intake. All patients were asked to fax or mail their BG values in 2 weeks for evaluation and telephone consultation with a CDE. The team regularly updated the referring physician on patients' status by fax or phone.

Using goals identified<sup>13</sup> from the American Association of Diabetes Educators,<sup>14</sup> patients selected personal goals at their

IV and signed an informal goal-setting agreement. Patients were then scheduled for 2 classes with CDEs over the next few months and a subsequent FUV, and they were encouraged to keep the appointments. Typically the time between the IV and the FUV was 4.5 months. Depending on insurance requirements and personal abilities, patients were given the opportunity to return for classes or for individual instruction. This study did not explore possible differences in results between patients receiving individual or group diabetes education.

Classes with the CDEs consisted of 2 to 16 patients and family members and provided information in a discussion-style format. Presentations and lecture-style formats were also used. Each participant received a book with supportive written materials as well. Participants were encouraged to ask questions and to express special needs.

At the FUV, patients' answers to the Registry were re-evaluated, including whether patients had met the goals set during their IV. Statistical comparisons were made between IV and FUV values. The answers were blinded.

## RESULTS

A total of 1702 patients had an IV in 2003 or 2004, but only 501 (29.4%) patients also had a FUV. Mean time between the IV and the FUV was 4.5 months. The following results are based on the 501 patients.

### A1C Level

A1C level is a key measure of the impact of DM control. For each 1% decrease in A1C level, there is a significant decrease in complications of DM.<sup>6</sup> The mean A1C level at the IV was 7.9%; the mean A1C level at the FUV was 6.7% ( $P = 0.001$ ) (**Figure**).

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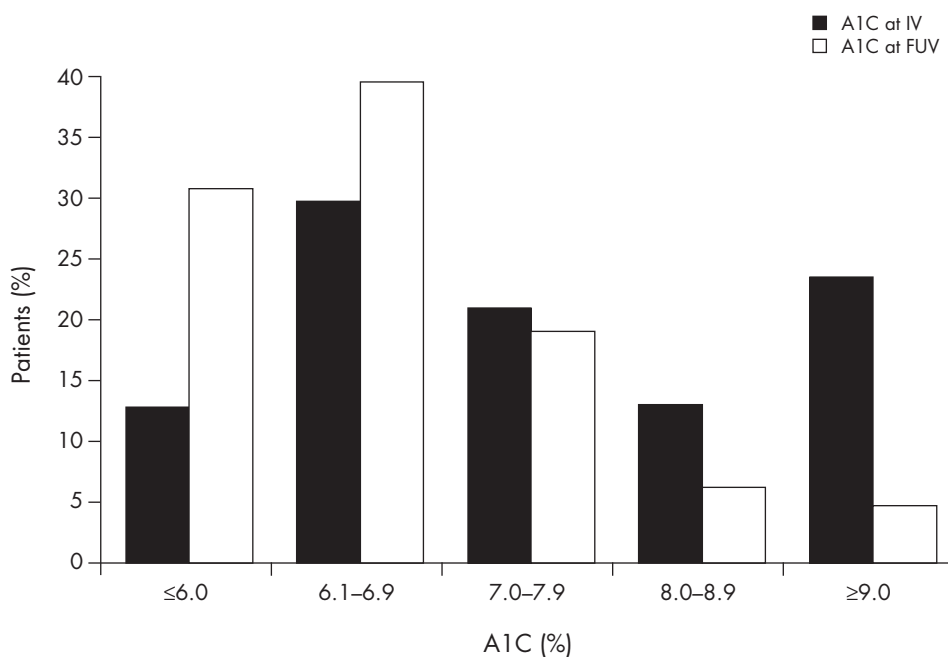
Not only did the mean A1C value decrease significantly, but each group (ie, <7.0% and ≥7.0%) showed improvement (**Table I**). An A1C level <7.0%, as recommended by the ADA, helps reduce the risk of heart disease, stroke, and complications of DM.<sup>1,7</sup> **Table I** indicates that only 42.2% (211) of the patients had an A1C level <7.0 at the IV. This number increased to 69.4% (348) at the FUV. At the IV, 57.8% (290) of patients had an A1C ≥7.0%; at the FUV, 30.6% (153) of patients had an A1C ≥7.0%.

### Weight

Patients' mean weight decreased from 198.6 to 196.0 lb between the IV and FUV ( $P = 0.001$ ).

### Blood Pressure

There was no significant change in mean systolic blood pressure between the IV (132.8 mm Hg) and the FUV



**Figure.** Mean glycosylated hemoglobin (A1C) results for 2003–2004. IV = initial visit; FUV = follow-up visit.

**Table I.** Comparison of glycosylated hemoglobin (A1C) levels at initial visit (IV) and follow-up visit (FUV).

Mean A1C Levels for Patient Groups <7.0% and ≥7.0%	No. (%) of Patients at IV	No. (%) of Patients at FUV
≤6.0	63 (12.5)	154 (30.7)
6.1–6.9	149 (29.7)	194 (38.7)
7.0–7.9	105 (21.0)	95 (19.0)
8.0–8.9	66 (13.2)	33 (6.6)
≥9.0	118 (23.6)	25 (5.0)
No. (%) of patients with A1C <7.0%	211 (42.2)	348 (69.4)
No. (%) of patients with A1C ≥7.0%	290 (57.8)	153 (30.6)

Patient Group	Mean A1C (%) at IV	Mean A1C (%) at FUV	P
<7.0% A1C at IV	6.2	6.1	NS
≥7.0% A1C at IV	9.1	7.1	0.001

(131.5 mm Hg). Diastolic blood pressure decreased from 79.4 to 77.1 mm Hg ( $P = 0.001$ ).

**Medication Adherence**

A total of 15 different medications were tracked. Patients identified the medications they were taking at both the IV and FUV. Results are shown for antihypertensive agents, aspirin, injectable insulin, and insulin sensitizers. **Table II** illustrates the differences between the IV and FUV. Although medication

adherence increased significantly between the IV and FUV for all 4 classes of medication ( $P = 0.001$ ), the most significant improvements occurred for aspirin and injectable insulin.

**Exercise Activity**

At the IV, 203 (42%) patients indicated that they did not exercise (ie, do any planned activity for ≥30 minutes each day). At the FUV, this number had decreased to 65 patients.

**Table II.** Change in medication use between initial visit (IV) and follow-up visit (FUV).

Medication Group	Patients Taking Medications at IV, %	Patients Taking Medications at FUV, %
Antihypertensive agents	77.6	83.3
Aspirin	26.3	47.4
Injectable insulin	28.6	46.7
Insulin sensitizers	59.4	63.9

Medication Group	Mean A1C at IV, %	Mean A1C at FUV, %
Antihypertensive agents*	7.8	6.7
Aspirin*	7.8	6.7
Injectable insulin*	8.8	7.3
Insulin sensitizers*	8.1	6.7

A1C = glycosylated hemoglobin.

\* $P = 0.001$ , all comparisons.

**Table III** indicates that 92 patients did no exercise at the FUV. This included the 65 patients who never exercised plus the 27 who originally exercised but subsequently stopped exercising. In total, 58% were exercising at the IV. This increased to 81% at the FUV. Note also that the frequency of exercising increased for all exercise categories after education by the CDE.

### Blood Glucose Monitoring

The number of patients who initially did not monitor their BG levels decreased from 229 (46.8%) at the IV to 10 (2.0%) at the FUV (**Table IV**).

The correlation between monitoring and A1C is shown in **Table V**. This table shows that for all 3 monitoring groups the mean value for A1C decreased between the IV and FUV ( $P = 0.001$ ). These results were accomplished in large part because the CDEs not only stressed the importance of frequent monitoring but more importantly taught the patients to know which corrective actions to choose.

A1C for the 6 patients who did no monitoring at either their IV or FUV increased slightly. Although not statistically significant because of the small number of patients, this finding warrants further investigation.

**Table III.** Change in the number of patients exercising between initial visit (IV) and follow-up visit (FUV).

Frequency of Exercise, Times/Week	No. (%) of Patients Exercising at IV	No. (%) of Patients Exercising at FUV
None	203 (42)*	92 (19)
<3	84 (17)	127 (26)
3	60 (12)	122 (24)
>3	140 (29)	154 (31)
Unanswered	14	6

\*Of the 203 patients, 138 began to exercise at the FUV, and their mean glycosylated hemoglobin level decreased from 8.0% to 6.8% ( $P = 0.001$ ).

**Table IV.** Change in the number of patients monitoring blood glucose levels between initial visit (IV) and follow-up visit (FUV).

Frequency of Monitoring, Times/Day	No. (%) of Patients at IV*	No. (%) of Patients at FUV*
None	229 (46.8)	10 (2.0)
1 or Occasionally	75 (15.3)	100 (20.6)
2	59 (12.1)	142 (29.2)
3	40 (8.2)	84 (17.3)
≥4	86 (17.6)	150 (30.9)
Unanswered	12	15

\*Percentages exclude unanswered.

**Table V.** Mean glycosylated hemoglobin (A1C) level versus frequency of blood glucose monitoring between initial visit (IV) and follow-up visit (FUV).

Monitoring Group	Mean A1C at IV, %*	Mean A1C at FUV, %*
No monitoring at IV; some at FUV <sup>†</sup>	8.1	6.8
Once/occasionally at IV; some at FUV <sup>†</sup>	7.8	6.9
≥2 Times at IV; some at FUV <sup>†</sup>	8.2	6.8

\*Six patients did not monitor at either visit.

<sup>†</sup>P = 0.001, all comparisons.

**Table VI.** Percentage of patients meeting American Association of Diabetes Educators<sup>14</sup> goals.

Goal	No. of Patients Setting Goals at IV	No. (%) of Patients Meeting Goals at FUV*
Healthy eating	331	227 (68.6)
Activity	280	143 (51.1)
Monitoring glucose	285	184 (64.6)

IV = initial visit; FUV = follow-up visit.

\*~25% to 30% of patients had no answer at FUV.

## Goals

Table VI shows the number of patients setting goals at the IV and meeting these goals at the FUV. Note that 68.6% (227) of patients met their healthy eating goal, 64.6% (184) met their monitoring glucose goal, and 51.1% (143) met their activity goal.

## DISCUSSION AND CONCLUSIONS

The diabetes education program at Saint Joseph's Hospital, Center for Diabetes Care, has helped patients reduce their A1C and make healthier lifestyle choices. Stressing healthy eating, regular exercise, adherence to prescribed medication regimens, regular monitoring and treatment of BG levels, and assisting patients to set and meet individual goals all contributed to a significant reduction in A1C levels.

Our findings and other data<sup>14</sup> suggest that diabetes education provided by CDEs can improve the lives of people with DM. Educators are creating innovative ways of providing diabetes education to patients that help change behaviors and therefore improve key indicators related to DM.<sup>5</sup> Even patients who check their BG levels frequently may not

have the understanding and skills they need to achieve an adequate A1C level without diabetes education. Educated BG monitoring may thus play an important role in control of BG levels. With pay-for-performance issues of increasing concern,<sup>15</sup> diabetes educators must provide primary caregivers and patients with tools to improve their DM, and the motivation and understanding to help them meet their goals. Additional studies are needed on the effectiveness of ADA-approved diabetes education in the outpatient setting.

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**Appendix.** Diabetes Registry.

	Initial visit	Follow-up visit
1. Name:	2. S.S. #:	3. Date of visit:
4. Type of diabetes: Type 1	Type 2	Other
Medical record #:		
5. Height:		
6. Weight:		
7. Systolic blood pressure:		
8. Diastolic blood pressure:		
9. Glycosylated hemoglobin level:		
10. Medications:		
<input type="checkbox"/> None	<input type="checkbox"/> Insulin (basal only)	
<input type="checkbox"/> Angiotensin-converting enzyme inhibitors/angiotensin II receptor blockers	<input type="checkbox"/> Insulin corrections only	
<input type="checkbox"/> Antiplatelet medications	<input type="checkbox"/> Insulin secretagogues	
<input type="checkbox"/> Aspirin	<input type="checkbox"/> Rosiglitazone, pioglitazone	
<input type="checkbox"/> Other antihypertensive medications	<input type="checkbox"/> Metformin	
<input type="checkbox"/> Lipid-lowering medications	<input type="checkbox"/> Combo: insulin sensitizers/secretagogues	
<input type="checkbox"/> Insulin: pump	<input type="checkbox"/> AlphaglucoSIDase inhibitors	
<input type="checkbox"/> Inject (multiple daily injections)	<input type="checkbox"/> Insulin sensitizer combination	
11. Health conditions #1		
<input type="checkbox"/> None	<input type="checkbox"/> Chest pain	
<input type="checkbox"/> Heart attack	<input type="checkbox"/> Stroke or transient ischemic attack	
<input type="checkbox"/> Hypertension	<input type="checkbox"/> Congestive heart failure	
<input type="checkbox"/> Heart bypass surgery		
12. Health conditions #2		
<input type="checkbox"/> None	<input type="checkbox"/> Amputations	
<input type="checkbox"/> Nephropathy	<input type="checkbox"/> Dialysis	
<input type="checkbox"/> Retinopathy	<input type="checkbox"/> Blindness	
<input type="checkbox"/> Neuropathy	<input type="checkbox"/> Elevated cholesterol level	
13. Dilated eye examination in the last year?		
14. Do you examine your feet?		
15. Smoking history:		

(continued)

**Appendix.** (Continued)

16. Exercise activity:	None	<3x/week	3x/week	>3x/week		
17. Did you have a flu shot last season?						
18. Pneumonia shot in the past 5 years?						
19. Do you monitor your blood glucose?	No	Daily	2x/day	3x/day	4 or more x/day	Occasionally
20. Setting and achieving behavior goals						
Initial visit				Achieved by follow-up visit		
___ Healthy eating				___yes	___no	
___ Activity				___yes	___no	
___ Monitoring				___yes	___no	
___ Taking medication				___yes	___no	
___ Problem solving				___yes	___no	
___ Healthy coping				___yes	___no	
___ Reducing risks				___yes	___no	
21. Your diabetes program:						
___ Diabetes management 2				___ Pump		
___ Diabetes management 1				___ Pregnancy		
___ Living with diabetes				___ Gestational		
___ Individual sessions				___ Spanish		
___ Prediabetes						