Gain in Patients' Knowledge of Diabetes Management Targets Is Associated With Better Glycemic Control

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Optimal glycemic, lipid, and blood pressure control has been shown to decrease the microvascular and macrovascular complications of diabetes (1–10). However, the status of control of these cardiovascular risk factors in individuals with diabetes is far from optimal (11,12). Lack of patients' knowledge of the targets of diabetes care might be one of the reasons for the low level of control of risk factors. Some studies showed that only 23–25% of individuals with diabetes know what the target A1C level is (<7%), and about the same percent of patients know how to interpret A1C values in relation to their own glycemic control (13,14). Improving patients' knowledge might help attain the goals of diabetes management, but the supporting studies are limited (14–18).

We investigated whether the gain in the knowledge of the targets of diabetes care after receiving diabetes self-management education (DSME) predicts the achievement of target A1C levels (<7%) at 6 months.

RESEARCH DESIGN AND METHODS

— This is a retrospective study of adult diabetic subjects who received DSME in the American Diabetes Association–certified Diabetes Center of John H. Stroger, Jr. Hospital of Cook County between 2001 and 2004.

Patients with baseline A1C levels ≥7% measured within 1 month of receiving DSME and with an ~6-month follow-up A1C measurement (ranging 3–12 months and at least 3 months from the baseline A1C) were selected for this study. A1C was measured by the high-performance liquid chromatography method throughout the study period. After the educational sessions, patients received follow-up medical care by endocrinologists in conjunction with their primary care providers.

A simple five-item questionnaire (found in an online appendix, "ABC test," at http://dx.doi.org.10.2337/dc06-2026) on glycemic control, blood pressure, and LDL cholesterol targets, as recommended by American Diabetes Association (19), was administered to English-speaking patients before (pretest) and after (posttest) DSME. The correct answer for each question carried a score of 20%. The test was validated by a method similar to the one developed by Paddock et al. (20).

The opportunity to show improvement from pretest to posttest was not the same for all individuals. It was higher for patients with lower pretest scores and vice versa, as was also noted in other training programs (21). Based on this consideration, the knowledge gain was measured in relation to the baseline score. Subjects were classified into "low baseline knowledge group" if their pretest score was ≤40% and "high baseline knowledge group" if their pretest score was >40%. We defined knowledge gainers as achievers of a posttest score of ≥80 and 100% for the low and high baseline knowledge groups, respectively. Patients with lower than these posttest scores were classified as nongainers. The posttest score cutoff, ≥80%, was chosen for the first group to assess the effect of considerable knowledge gain (≥ ×2) on study outcome, and the posttest score of 100% was chosen for the next group to allow maximal possible gain in the score. Patients with a pretest score of 100% were classified as nongainers if their posttest score was lower.

Knowledge gain as a predictor of target A1C achievement was tested by logistic regression using SPSS version 12.0 (Chicago, IL). The tests were two-sided with a 5% significance level.

RESULTS

— A total of 155 subjects met the eligibility criteria, 94% had the baseline A1C performed on or within 1 month before the day of receiving DSME, and 97% had type 2 diabetes. A total of 93 subjects (60%) were classified as knowledge gainers, and 62 subjects (40%) were classified as nongainers. Patient characteristics including demographic variables, duration of diabetes, BMI, baseline A1C, number of follow-up visits to the diabetes center, and the duration of follow-up were similar between knowledge gainers and nongainers as shown in Table 1.

Overall, 5.2% of the patients were new to diabetes therapy during the study, and there was a slightly higher use of combination therapy with oral agents plus insulin (13.5 vs. 16.8%) at follow-up. Though the hypoglycemic therapy deemed appropriate by the treating physicians somewhat changed over time, there were no significant differences in the type of therapy between study groups at baseline ($P = 0.47$) or at follow-up ($P = 0.74$), as shown in Table 1. Furthermore, there was no difference in the number of oral agents between gainers and nongainers at follow-up (monotherapy, 87.5 vs. 86.4%; dual therapy 12.5 vs. 11,4%; and triple therapy, 0 vs. 2.3%, respectively).

Overall, A1C decreased from 10.1 ±

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Abbreviations: DSME, diabetes self-management education.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

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Table 1—*Comparison of baseline and follow-up characteristics in knowledge gainers and nongainers*

Characteristic	Knowledge gainers	Nongainers	*P*
n (%)	93 (60)	62 (40)	
At baseline			
Sex*			0.19
Male	52.7	41.9	
Female	47.3	58.1	
Ethnicity*			0.16
African American	51.6	66.1	
Caucasian	12.9	9.7	
Asian	18.3	16.1	
Hispanic	11.8	1.6	
Other	5.4	6.5	
Education*			0.48
Less than high school	20.4	24.2	
High school	7.5	4.8	
Some college/trade school	52.7	59.7	
College graduation	19.4	11.3	
Employment*			0.24
Unemployed	74.2	85.5	
Part time	17.2	9.7	
Full time/data not available	8.6	4.8	
Age in years (mean ± SD)†	53.2 ± 10.9	56.0 ± 11.4	0.12
Duration of diabetes in years (median 25th, 75th percentiles)‡	1.5 (0.5, 11.5)	1.5 (0.5, 9.5)	0.61
BMI (kg/m^2)†	32.7 ± 8.0	31.4 ± 10.1	0.38
A1C % (median)‡	10.2 ± 2.1 (9.7)	9.9 ± 2.5 (9.1)	0.13
Type of diabetes therapy*			0.47
Oral agents	62.4	72.6	
Insulin	16.1	8.1	
Insulin + oral agents	14.0	12.9	
No therapy or data not available	7.5	6.5	
Pretest score (%)†	52.0 ± 26.2	47.4 ± 25.2	0.34
Mean improvement in score (%)§			
Entire group	44.3 ± 23.6	17.1 ± 19.5	<0.001
Low baseline knowledge group‖	63.2 ± 15.5	27.4 ± 15.1	<0.001
High baseline knowledge group¶	28.7 ± 16.3	6.3 ± 15.6	<0.001
At follow-up			
Follow-up in months†	6.5 ± 2.3	6.4 ± 2.0	0.79
Diabetes center visits†	3.7 ± 1.6	3.6 ± 1.5	0.59
A1C % (median)‡	7.6 ± 1.9 (7.1)	7.9 ± 1.9 (7.5)	0.18
Type of diabetes therapy*			0.74
Oral agents	68.8	71	
Insulin	12.9	9.7	
Insulin + oral agents	17.2	16.1	
No therapy or data not available	1.1	3.2	
Subjects attaining target A1C**			
Entire group	46	29	0.03
Low baseline knowledge group‖	45.5	20	0.02
High baseline knowledge group¶	46.9	37.5	0.20

Data are % or means ± SD. *Pearson's χ^2 (categorical variables). †Two-sample *t* test (normally distributed). ‡Mann-Whitney analysis (nonparametric). §Paired Wilcoxon analysis. ‖Subjects with a pretest score of ≤40%. ¶Subjects with a pretest score of >40%. **Logistic regression.

2.3% at baseline to 7.7 ± 1.9% at 6.4 ± 2.1 months follow-up ($P < 0.001$) with 39.4% achieving the target A1C levels of <7%. The target A1C achievement was higher in knowledge gainers versus nongainers (46 vs. 29%, $P = 0.032$). Knowledge gain remained an independent predictor of target A1C achievement with an odds ratio of 2.3 (95% CI of 1.1–5.0%, $P = 0.028$) after adjusting for baseline A1C, duration of diabetes, sex, ethnicity, BMI, and the number of visits to the diabetes center.

In particular, subgroup analysis showed the gainers in the low baseline knowledge group attained more than twofold higher target A1C rate (45.5%) than nongainers (20%, $P = 0.021$). In the high baseline knowledge group, target A1C rates were higher in the gainers (46.9%) than nongainers (37.5%), but the difference was not statistically significant ($P = 0.2$).

CONCLUSIONS — Our results showed that the gain in the knowledge of the targets of diabetes care after receiving DSME independently predicted the achievement of target A1C levels. The difference in the target A1C achievement rate between knowledge gainers and nongainers was significant in the low baseline knowledge group but not in the high baseline knowledge group.

Rothman et al. (22) reported similar results with their multidisciplinary diabetes management program, where the intervention patients achieved significantly higher target A1C rates than control subjects in the low literacy group but not in the high literacy group.

Knowledge gain, measured in relation to the baseline knowledge, was found to be a good indicator of the impact of diabetes education on glycemic control in this study. The DSME might have improved patients' understanding of the importance of reaching the targets and motivated them to adopt better self-management practices leading to better glycemic control in gainers, though our study is limited in that we did not evaluate the self-management behaviors.

The significant drop in A1C at follow-up for the entire group might be the result of a combination of factors—the effect of the multidisciplinary intervention, especially for some of the patients who might have previously lacked regular diabetes care. In addition, about one-half of the subjects had diabetes of relatively short duration (<1.5 years), which is more responsive to therapy.

This study suggests that patients with low baseline knowledge should receive special attention in DSME programs, as knowledge gain in this group can significantly improve glycemic control. Special educational interventions need to be considered for individuals who do not gain adequate

knowledge after standard DSME. Evaluation by simple pre- and posttests may help to identify such subjects.

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