Supporting Autonomy to Motivate Patients With Diabetes for Glucose Control

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OBJECTIVE — We applied the self-determination theory of human motivation to examine whether patient perceptions of autonomy supportiveness (i.e., patient centeredness) from their diabetes care providers related to improved glucose control over a 12-month period.

RESEARCH DESIGN AND METHODS — We conducted a prospective cohort study of patients with diabetes from a diabetes treatment center at a university-affiliated community hospital. Participants were 128 patients between 18 and 80 years of age who took medication for diabetes, had no other major medical illnesses, and were responsible for monitoring their glucose and taking their medications. The main outcome measure was a change in HbA_{1c} values over the 12 months of the study.

RESULTS — Patient perception of autonomy support from a health care provider related to a change in HbA_{1c} values at 12 months ($P < 0.05$). Further analyses showed that perceived autonomy support from the staff related to significant increases in patient autonomous motivation at 12 months ($P < 0.05$); that increases in autonomous motivation related to significant increases in perceived competence ($P < 0.05$); and that increases in a patient's perceived competence related to significant reductions in their HbA_{1c} values over 12 months ($P < 0.001$).

CONCLUSIONS — The findings support the prediction of the self-determination theory that patients with diabetes whose health care providers are autonomy supportive will become more motivated to regulate their glucose levels, feel more able to regulate their glucose, and show improvements in their HbA_{1c} values.

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Recent research convincingly demonstrated that better glucose control is associated with improved long-term health outcomes for patients with type 1 diabetes (1). Specifically, the Diabetes Control and Complications Trial (DCCT) confirmed that patients who were able to maintain glucose at near-normal levels had significantly less diabetic retinopathy, neuropathy, and nephropathy. Similar results were found in a study of patients with type 2 diabetes (2). Together, these important findings suggest that it is crucial for patients with diabetes to maintain their blood glucose at levels as close to the normal range as possible.

Patients in the DCCT were preselected in a way that likely ensured high motivation for controlling their glucose. This was necessary for establishing a clear link between glucose control and complications. Because of this, however, the study did not address the important questions of what motivational variables predict long-term glucose control and how health care providers can promote such motivation in patients with diabetes, many of whom are not as motivationally prepared as those selected for the DCCT (3). In the present study, we explored factors that were hypothesized to relate to the patient becoming more motivated for long-term glucose control, basing our work on a theory of human motivation called the self-determination theory (4).

This theory is built around the distinction between motivations that are autonomous versus controlled. Behavior is autonomously motivated to the extent that people experience a sense of volition, self-initiation, and personal endorsement of the behavior. On the other hand, behavior is controlled to the extent that people feel pressured to behave by some interpersonal or intrapsychic force. Patients taking medication would be autonomous if they took it because they believed in the medication's efficacy and were personally committed to improved health; whereas, their behavior would be controlled if they took the medication because their provider or spouse pressured them.

The practical importance of this distinction is that only autonomous motivation is expected to yield the long-term persistence and adherence that are needed for patients with diabetes to keep their glucose in a healthier range. Previous research of patients with other medical conditions has shown, for example, that individuals in an outpatient alcohol treatment program who were more autonomously motivated were subsequently more involved in the program and had better attendance than those with more controlled motivation (5). Also, patients in a weight-loss program who were more autonomous attended the 6-month program more regularly and maintained greater weight loss over 2 years than those who were more controlled (6).

The self-determination theory also considers the extent to which significant others in a person's social context are autonomy supportive, which means that significant others understand the person's perspective, acknowledges their feelings, offers choices, and provides relevant information. The theory proposes that a person will develop and maintain more autonomous motivation to the extent that significant others are auton-

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Abbreviations: DCCT, Diabetes Control and Complications Trial; HCCQ, Health Care Climate Questionnaire; PCDS, Perceived Competence for Diabetes Scale; T1, time 1 (start of study); T2, time 2 (four months after start of study); T3, time 3 (study completion at 12 months); TSRQ, Treatment Self-Regulation Questionnaire.

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

omy supportive (7). In health care, autonomy support can be viewed as an orientation of providers that is closely related to patient centeredness (8), and we hypothesize that providers who are more autonomy supportive in relating to patients could have a significant effect on patients' autonomous motivation to improve their condition (e.g., decreasing glycosylated hemoglobin).

Research has demonstrated that when doctors are perceived by their patients as being more autonomy supportive, the patients report greater autonomous motivation for taking their medications and better adherence to prescribed regimens (9). Perceived provider autonomy support has also been associated with morbidly obese patients reporting more autonomous reasons for participating in a weight-loss program, which was associated with better exercise and weight loss over the subsequent 2 years (6). Having a physician who is rated as more autonomy supportive by an objective observer was associated with autonomous motivation of smokers for quitting smoking, which was, in turn, related to better cessation at 6 months (10).

Perceived competence

Physicians generally assume that patients will display better adherence when they feel competent to carry out the prescribed regimens. Consequently, we included assessments of felt competence for diabetes management in this study. Past research, guided by the self-determination theory, revealed that individuals tend to feel more competent when they are autonomously motivated and that autonomy support enhances felt competence and autonomous motivation (11). In a study of smoking cessation, patients who perceived their doctors as more autonomy supportive experienced a significant increase in their felt competence for quitting, and those who felt more competent displayed better cessation at 6 months (10).

Promoting diabetes self-regulation

On the basis of this framework, we hypothesized that patients with diabetes who perceived their health care providers as being more autonomy supportive would improve their glucose control over the 12-month study period. Further, we hypothesized that autonomy support would affect change in HbA_{1c} values through a change in both autonomous motivation and felt competence. We expected perceived autonomy support to lead to an increase in autonomous motivation and for an increase in autonomous motivation to lead to an increase in felt competence, and finally, for an increase in felt competence to lead to improved glucose control over the 12-month study period (Fig. 1).

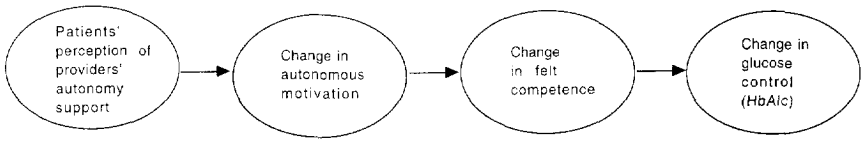

Figure 1—*Self-determination model illustrating how the provider-patient relationship can promote changes in the patient's psychological experience of autonomy and competence, which in turn leads to change in glucose control.*

No previous studies of patients with diabetes have used the specific constructs of autonomy support, autonomous motivation, and perceived competence that are central to the self-determination theory. Therefore, the present study was designed to extend the results from previous studies of patients with other medical conditions to patients with diabetes, as well as to validate the research instruments for patients with diabetes.

However, several studies of patients with diabetes have used concepts that are related to concepts of the self-determination theory; for example, self-efficacy is closely related to perceived competence. Although in studies of patients with diabetes, self-efficacy has typically been assessed with respect to specific diabetes-relevant behaviors (12), we assessed perceived competence as a general variable of patients feeling able to successfully manage their diabetes. Further, both patient empowerment (13) and motivational interviewing (14) involve health care providers relating to patients in ways that are similar to the relational style encompassed by the concept of autonomy support.

In one study (12), behavior-specific self-efficacy predicted exercise self-care, and to a lesser extent, dietary and glucose-testing behaviors. In clinical trials, patient empowerment led to enhanced self-efficacy and reduced glycosylated hemoglobin over 12 weeks (13), and motivational interviewing led to improved diabetes-relevant behaviors, such as completing food diaries and recording glucose levels, and to improved HbA_{1c} over 16 weeks (14). These findings are all consistent with our current predictions and past studies involving patients with other diseases. The current study, which builds on these past findings, was intended to lengthen the time-frame for changes in HbA_{1c} and to test an overall model of change.

RESEARCH DESIGN AND METHODS

Participants

Participants were recruited from a diabetes center at a university-affiliated community hospital. Eligibility criteria included patients <80 years of age, ability to speak and read English, and having no diseases with a life expectancy of <1 year. A total of 149 patients with diabetes agreed to participate after being asked by a research assistant or reading a sign in the center describing the study. A total of 128 (86%) of these patients (47 with type 1 diabetes and 81 with type 2 diabetes) completed the study.

Procedure

Participants were informed that the study would involve completing questionnaires three times over a 1-year period and having their HbA_{1c} checked at the time of each questionnaire. Participants were guaranteed that their responses would be kept confidential and that no one other than the research team would see their data. Each participant received $20 at the end of the study.

The packet at time 1 (T1, start of study) included the Treatment Self-Regulation Questionnaire (TSRQ), which measures autonomous versus controlled motivation for regulating diabetes; the Perceived Competence for Diabetes Scale (PCDS), which assesses feelings of competence; and demographic questions, including age, sex, education level, marital status, race, and household income. The first HbA_{1c} level was obtained at that time. Approximately 4 months later, at time 2 (T2), patients completed a second packet, which included the Health Care Climate Questionnaire (measuring their perceptions of the staff's autonomy supportiveness), the TSRQ, and the PCDS. After completion of the questionnaires, patients were given their HbA_{1c} results. After 12 months, at time 3 (T3), they

Table 1—*Comparison of participants who dropped out with those who completed the study*

	Dropouts	Completers	*P*
n	21	128	
Demographic variables			
Age (years)	46.0	54.5	0.01
Education level (1–6)	3.8	4.2	0.23
Household income (1–9)	5.3	6.2	0.10
Marital status (% married or living together)	66.7	77.3	0.28
Sex (% female)	57.1	56.3	0.94
Race (% white)	65.0	85.9	0.02
Diabetes variables			
Age of onset (years)	34.6	40.8	0.13
Duration of diabetes	11.4	13.7	0.30
Complications	0.4	0.9	0.02
Visits to diabetes center			
Before study	12.0	19.9	0.03
During study year	2.7	5.0	0.005
Percentage of patients with type 1 diabetes	29	37	0.55
Treatment type (%)			
Diet and exercise	4.8	4.7	0.99
Oral medication	33.0	17.0	0.08
Insulin	57.0	52.0	0.64
Insulin and oral	4.8	16.4	0.16
Pump	0.0	10.9	0.11
Motivation variables			
Autonomous reasons	24.6	26.0	0.07
Controlled reasons	15.8	15.4	0.92
Perceived competence	21.0	23.7	0.12
Outcome variable			
HbA_{1c} (%)	8.6	8.4	0.63

Complications were defined as neuropathy, nephropathy, and retinopathy.

again completed the TSRQ and PCDS and were then given their HbA_{1c} results.

Chart reviews were conducted to ascertain the following information: type of diabetes; age of onset of diabetes; duration of diabetes; number of complications (neuropathy, retinopathy, and nephropathy); number of visits to the diabetes center before participation in the study; number of visits to the center during the study; and type of treatment (diet and exercise only or diet and exercise in addition to one of the following: oral hypoglycemic medication, insulin injections, insulin injections plus oral medication, or insulin pump).

Instruments

Modified Health Care Climate Questionnaire (HCCQ). This scale assesses participants' perceptions of the degree of autonomy supportiveness (versus "controllingness") of their health care providers in the diabetes center (physician, nurse educator, and dietician). It includes items such as "I feel that my health care providers provided me with choices and options about handling my diabetes." Responses were made on a 7-point Likert-type scale ranging from "strongly disagree" to "strongly agree." The original HCCQ has 15 items that have been used in studies of weight loss (6) and smoking cessation (10), with a Cronbach α of 0.92 and 0.96, respectively. To reduce item redundancy and facilitate analyses in the smoking cessation study, 5 items that were judged to be the most representative of the concept of autonomy support were selected from the original 15. This shortened version of the scale had a Cronbach α of 0.80 and correlated 0.91 with the full scale, thus indicating that the modified scale was a fully adequate version of the longer HCCQ. A factor analysis of the five items using 1,183 patients who completed the questionnaire in various studies yielded a one-factor solution (eigenvalue = 3.0, with all factor loadings above 0.74). In that data set, the Cronbach α for the five items was 0.84, and the five-item total correlated 0.95 with the 15-item total. In the present study, the Cronbach α for the five items was 0.80.

The HCCQ was given to assess autonomy support at T2. We did not use the measure at T1 because patients who were new to the diabetes center would not have had the experience necessary to describe the providers' interpersonal styles. Further, we did not use the measure at T3 because we did not want concomitant measurement of the primary predictor variable (autonomy support) and the primary dependent variable (HbA_{1c}). Because analyses have shown that patients' perceptions of providers are reasonably stable over time, with 6- to 8-month correlations being approximately 0.6, it seemed reasonable to use the HCCQ only at T2.

TSRQ. The TSRQ for diabetes, which used an approach to assessing self-regulation introduced by Ryan and Connell (15), measured autonomous and controlled motivations for following a diabetic diet and for exercising regularly. Participants are presented with a stem, which in this case was "The reason I follow my diet and exercise regularly is that." The stem is followed by items that represent reasons that vary in the degree to which they reflect autonomous motivation. Examples of more controlled reasons are "Other people would be upset with me if I didn't" and "I would be ashamed of myself if I didn't." Examples of more autonomous reasons include "I personally believe that these are important in remaining healthy" and "I've carefully thought about my diet and exercising and believe they are the right things for me to do." Participants completed the questionnaire at each of the three times by rating each reason on 7-point Likert-type scales ranging from "strongly disagree" to "strongly agree." The TSRQ, which has eight items, four on each subscale, was adapted slightly from the TSRQ used in a weight-loss study (6). The Cronbach α's on the autonomy and controlled subscales at the three points in time for the patients in this study are shown in Table 2. All were excellent. Further, autonomous reasons at T1 correlated with the same variables at T2 by 0.66 and at T3 by 0.60. Controlled reasons at T1 correlated with the same variable at T2 by 0.71 and at T3 by 0.64 (all $P < 0.001$).

PCDS. The PCDS includes three items modified for diabetes from similar perceived competence scales used in predicting smoking cessation for patients and educational

outcomes for medical students (10,16). In these previous studies, the scale has had excellent internal consistency (Cronbach α's between 0.80 and 0.94). In factor analyses with items from other motivational constructs, such as autonomous motivation, controlled motivation, and interest, the perceived competence items have loaded cleanly onto a separate factor. In the smoking-cessation study, perceived competence for quitting was significantly enhanced by autonomy-supportive providers (10); and in a medical education study, perceived competence for interviewing patients was significantly enhanced by autonomy-supportive instructors (11). Thus, past research supports the internal consistency and construct validity of this measure. In the present sample, the Cronbach α's, as reported in Table 2, were excellent. Further, perceived competence at T1 correlated with that variable at T2 by 0.57 and at T3 by 0.55 ($P < 0.01$).

HbA_{1c}. The HbA_{1c} tests were analyzed by the community hospital's high-performance liquid chromatography (Bio-Rad Variant Analyzer, Hercules, CA). Normal values at this lab are 4.1–6.5%.

Statistical analysis

Correlations, *t* tests, and χ^2 analyses were used to compare dropouts to those who completed the study and to test the relations of the demographic variables to the outcomes. Multiple regressions were used to test the hypotheses of the study. The primary regression analysis explored changes in HbA_{1c} from T1 to T3 (12 months) as a function of perceived autonomy support at T2, with this effect occurring through changes in both autonomous motivation and perceived competence from T1 to T2. Even though our analysis does not allow causal conclusions, using assessments of the psychological variables done before assessment of HbA_{1c} is most appropriate for testing the hypothesized relations. We then repeated the analysis removing the variance attributed to each of the diabetes-related variables ascertained from the chart reviews. Finally, we replicated the analyses using variables measured concomitantly.

RESULTS

Preliminary analyses

Comparisons between the 128 patients who completed the study and the 21 who dropped out revealed that the group of patients who did not complete the study had a lower percentage of whites (65 vs. 86%, $P < 0.05$), a lower mean age (46 vs. 54.5 years old, $P < 0.05$), fewer complications (0.4 vs. 0.9, $P < 0.05$), fewer visits to the center before they began the study (12 vs. 20, $P < 0.05$), and fewer visits during the study period (2.7 vs. 5.0, $P < 0.01$). The two groups did not, however, differ significantly on any motivational variable, type of diabetes, type of treatment, or HbA_{1c} at T1 (Table 1).

The 128 participants who compose the study sample were 54.5 years old, with some college education and a household income of nearly $41,000 per year. Seventy-seven percent were married or living with someone, 56% were women, and 86% were white. Average age at onset was 41 years, average duration of the diabetes was 13.7 years, and average number of complications was just less than one. On average, participants had visited the diabetes center 19 times before they began the study and visited 5 times during the study. The participants' average HbA_{1c} was 8.4 at T1, which fell significantly to 8.1 ($P < 0.01$) by T2, and to 8.0 ($P < 0.01$) by the end of the study. The HbA_{1c} values for type 1 patients did not differ from the values for type 2 patients at T1, T2, or T3. Means, SDs, and ranges for the study variables are reported in Table 2.

If a demographic variable was related to HbA_{1c} values at T2 and T3 with a *P* level of ≤0.20, it was included in the regression analyses to predict changes in HbA_{1c}. Sex

Table 2—*Study variables*

	Mean ± SD	Range	α
Demographic variables			
Age (years)	54.5 ± 13.8	56	—
Education level (1–6)	4.2 ± 1.2	5	—
Household income (1–9)	6.2 ± 2.1	8	—
Marital status (% married or living together)	77	—	—
Sex (% female)	56	—	—
Race (% white)	86	—	—
Diabetes variables			
Age of onset (years)	40.8 ± 17.3	74	—
Duration of diabetes	13.7 ± 9.3	37.9	—
Complications	0.9 ± 1.0	3	—
Visits to diabetes center			
Before study	19.9 ± 15.7	77	—
During study year	5.0 ± 3.2	18	—
Percentage of participants with type 1 diabetes	37	—	—
Motivation variables			
Autonomy support			
T2	29.0 ± 5.2	26	0.80
Autonomous reasons			
T1	26.0 ± 3.2	22	0.81
T2	25.8 ± 3.3	18	0.83
T3	25.3 ± 3.7	22	0.85
Controlled reasons			
T1	18.9 ± 6.8	24	0.86
T2	19.2 ± 6.1	24	0.80
T3	19.1 ± 6.5	24	0.85
Perceived competence			
T1	23.8 ± 4.1	19	0.85
T2	23.5 ± 4.3	24	0.87
T3	23.8 ± 4.3	18	0.84
HbA_{1c} (%)			
T1	8.4 ± 1.9	16	—
T2	8.1 ± 1.4	10	—
T3	8.0 ± 1.6	12	—

Complications were defined as neuropathy, nephropathy, and retinopathy.

Table 3—*Relationship of demographic variables to HbA_{1c} at T2 and T3*

	HbA_{1c}	
	T2	T3
Age (years)	−0.09	−0.06
Educational level (1–6)	0.06	0.03
Household income (1–9)	0.0	−0.10
Marital status		
Single or divorced	8.2	8.4
Married or living together	8.0	7.9
Sex		
F	8.0	7.8
M	8.1	8.2*
Race		
Nonwhite	8.1	8.1
White	8.0	8.0

Data in the first three rows are correlations between the continuous demographic variables; data in the remaining rows are means of HbA_{1c} scores for the specified categories of the noncontinuous variables. *$P \leq 0.20$.

Table 4—*Correlations of study variables with HbA_{1c} at T1, T2, and T3*

	HbA_{1c}		
	T1	T2	T3
Diabetes variables			
Age of onset (years)	−0.10	−0.19†	−0.19†
Duration of diabetes	0.13	0.23‡	0.28§
Complications	0.17*	0.26‡	0.29§
Visits to diabetes center			
Before study	−0.11	−0.08	−0.09
During study year	0.07	0.03	−0.02
Percentage of participants with type 1 disease	0.04	0.12	0.09
Treatment type			
Diet and exercise	−0.18†	−0.22†	−0.09
Oral medication	−0.01	−0.16*	−0.06
Insulin	0.05	0.12	0.02
Insulin and oral	−0.15*	0.24‡	0.24‡
Pump	−0.12	−0.12	−0.11
Motivation variables			
Autonomy support			
T2	−0.13	−0.23‡	−0.21†
Autonomous reasons			
T1	−0.40§	−0.37§	−0.38§
T2	−0.26‡	−0.28§	−0.33§
T3	−0.30§	−0.24‡	−0.30§
Controlled reasons			
T1	0.05	−0.08	0.02
T2	−0.02	−0.14	−0.03
T3	−0.08	−0.17*	−0.16*
Perceived competence			
T1	−0.35§	−0.38§	−0.30§
T2	−0.19†	−0.36§	−0.37§
T3	−0.12	−0.19*	−0.26‡

*$P < 0.10$; †$P < 0.05$; ‡$P < 0.01$; §$P < 0.001$.

was the only variable that met this criterion (Table 3).

Correlations of the motivation variables with HbA_{1c} were all in the expected directions. Autonomy support was significantly negatively related to HbA_{1c} at T2 and T3 ($r = -0.23$, $P < 0.01$ at T2; -0.21, $P < 0.05$ at T3). Autonomous motivation was strongly negatively related to HbA_{1c} at all three times ($r = -0.40$, -0.28, and -0.30, respectively, $P < 0.001$). Perceived competence was significantly negatively related to HbA_{1c} at all three times ($r = -0.35$, $P < 0.001$ at T1; -0.36, $P < 0.001$ at T2; and -0.26, $P < 0.01$ at T3). These relations are all moderate to strong. Controlled motivation was not significantly correlated with HbA_{1c}, so this variable was not included in further analyses (Table 4).

Change analyses

A hierarchical multiple regression was used to test our central hypothesis that change in HbA_{1c} from T1 to T3 would be predicted by perceived autonomy support (after controlling for sex). To test this hypothesis, HbA_{1c} at T3 was regressed onto HbA_{1c} at T1 (thus creating change scores), and then onto sex and perceived autonomy support. Perceived autonomy support was significant ($B = -0.13$, $P < 0.05$), which means that it did significantly predict reductions in HbA_{1c} over the 12 months, accounting for 2% of the variance (Table 5).

We then performed analyses to determine whether this relation of autonomy support to change in HbA_{1c} (T1 to T3) was independent of any relations between diabetes-relevant variables and change in HbA_{1c}. To avoid exceeding the ratio of 1 variable to 10 participants, we did two analyses, entering one block of diabetes-relevant variables in each. First, we formed dummy codes for the five treatment types and then regressed HbA_{1c} (T3) onto HbA_{1c} (T1), sex, and the block of dummy codes. This block representing treatment type did not account for significant variance, nor did any one of the treatment types, so this was excluded from further analyses. In the second analysis, we regressed HbA_{1c} (T3) onto HbA_{1c} (T1), sex, and the block of the six remaining diabetes-relevant variables (type of diabetes, age of onset, duration of diabetes, number of complications, number of visits to the center before participation in the study, and number of visits to the center during the study). This set of variables was significant [the block $\Delta F(1,124) = 2.38$, $P < 0.05$], although no individual variable accounted for significant variance. We then added autonomy support, and it still accounted for significant independent variance in the change in HbA_{1c} ($B = -0.15$, $P < 0.05$). The significant effect sizes of these various relations, measured in terms of variance accounted for, tended to be in the weak-to-moderate range.

Because diabetes type is particularly important, and the studies relating glycemic control to long-term complications were done separately for patients with type 1 and type 2 diabetes, we performed a further analysis in this set of primary analyses. We regressed HbA_{1c} (T3) onto HbA_{1c} (T1), sex, type of diabetes, perceived auton-

Table 5—*Values for multiple regression analyses demonstrating changes in HbA_{1c} from T1 to T3 and changes in autonomous reasons and perceived competence from T1 to T2*

Independent variables	Dependent variables
	HbA_{1c} (T3), df = 4,123
HbA_{1c} (T1)	0.65†
Sex	0.08
Autonomy support	−0.13*
	Autonomous reasons (T2), df = 2,125
Autonomous reasons (T1)	0.60†
Autonomy support	0.15*
	Perceived competence (T2), df = 3,124
Perceived competence (T1)	−0.55†
Autonomous reasons	
T1	−0.07
T2	0.31†
	HbA_{1c} (T3), df = 4,123
HbA_{1c} (T1)	0.65†
Sex	0.02
Perceived competence	
T1	0.11
T2	−0.31†

*$P < 0.05$; †$P < 0.001$.

omy support, and the interaction between diabetes type and perceived autonomy support to determine whether the effects of perceived autonomy support on changes in HbA_{1c} would be the same for the two types of diabetes. Neither diabetes type nor the interaction between diabetes type and perceived autonomy support accounted for significant variance. In sum, both patients with type 1 and those with type 2 diabetes who experienced their providers as more autonomy supportive showed improvement in their glucose regulation.

In testing the secondary motivational hypotheses, we explored each of the three relations depicted by arrows in Fig. 1 using change in HbA_{1c} from T1 to T3 and using psychological variables from T1 and T2. We proceeded from left to right in testing the three proposed relations shown in the figure. First, we regressed autonomous reasons at T2 onto autonomous reasons at T1 and onto perceived autonomy support. Perceived autonomy support accounted for a significant increase in autonomous reasons in both equations ($B = 0.15$, $P < 0.05$). Next, perceived competence at T2 was regressed onto perceived competence at T1 and onto autonomous reasons at both T1 and T2. Change in autonomous reasons accounted for significant change in perceived competence ($B = 0.31$, $P < 0.001$). Finally, HbA_{1c} at T3 was regressed onto HbA_{1c} at T1, then onto sex and perceived competence at both T1 and T2. An increase in perceived competence accounted for a significant decrease in glycosylated hemoglobin ($B = -0.31$, $P < 0.001$) (Table 5).

Two additional analyses confirmed that the relation between autonomy support and change in HbA_{1c} was mediated by both autonomous motivation and perceived competence by showing that the effect of autonomy support dropped to insignificance when the autonomous motivation or perceived competence variables were entered into the same equation.

Supplemental analyses exploring changes in HbA_{1c} from T1 to T2 using T1 and T2 psychological variables and changes in HbA_{1c} from T1 to T3 using T1 and T3 psychological variables replicated the primary findings. Every one of the relations was significant, thus indicating that the model held for the 4-month and the 12-month periods using concomitant psychological and physiological data.

CONCLUSIONS — The current study was designed to test the application of self-determination theory to the problem of maintenance of blood glucose regulation by patients with diabetes. The results confirmed the primary hypothesis that care providers' being perceived as autonomy supportive would predict decreases in glycosylated hemoglobin over the 12-month maintenance period as well as over the initial 4-month period. Thus, it seems that when the health care climate is experienced as being rich with provision of choice, information about the problem, acknowledgment of the patients' emotions, and minimal pressure to behave in particular ways, patients may display improved physiological outcomes. We suggest that patients will be most likely to experience these factors in health care climates when providers support autonomy—in other words, when providers behave with what has been referred to as a patient-centered style (8).

The more detailed analysis of how perceived autonomy support led to changes in HbA_{1c} by affecting changes in patients' autonomous motivation and felt competence demonstrated support for self-determination theory and suggested that attention to psychosocial factors in patient care can have a significant influence on important physiological outcomes (17). The effect sizes for the change analyses were in the weak-to-moderate range, which, given that we were analyzing the covariance of change scores, represents substantial evidence for the model.

This study also considered a set of diabetes-related variables taken from a review of the patients' charts. The type of diabetes did not relate to change in HbA_{1c} over the 12 months, nor did the type of treatment the patients were receiving. A set of variables including age of onset and duration of treatment did affect change in HbA_{1c} when considered as a block, but the relation of autonomy support to change in hemoglobin was independent of the relation of the block of diabetes variables to change in hemoglobin.

The 21 patients who did not complete this study were compared with the 128 who did on demographic and diabetes-relevant variables. Those who dropped out tended to be younger, to be more likely to come from a minority group, to have fewer complications, and to have made fewer visits to the diabetes center than those who completed the study. It is difficult to know why the younger, minority, and less severely diseased patients were more likely to drop out of the study, but it does highlight the importance of obtaining representative samples. It is possible that the patients who were older, of majority status, and sicker were differentially treated, and that is reason for concern. Fortunately, in terms of the results of this study, the analyses confirmed that the relation of perceived autonomy support to change in glycosy-

lated hemoglobin existed independently of any variables that differentiated the completers from the noncompleters.

Our results confirming the relevance of the self-determination model to patients with diabetes complement those of other investigators who have assessed similar concepts for patients with diabetes (12–14) or have assessed the same variables for patients with different medical conditions (18–22). Together, they suggest that facilitating active or autonomous motivation in patients and supporting their feelings of competence may have a positive effect on patients' physical health outcomes. Further strengthening this conclusion is the fact that our research was based on a well-validated general theory of human motivation that has successfully predicted positive outcomes in education (23), business (24), and mental health (25).

Further research is called for to demonstrate that objective ratings of provider autonomy support also predict patients' motivation and health outcomes, that care providers can be trained to be more autonomy supportive, and that that training will in turn lead to improved patient outcomes (e.g., reduced HbA_{1c}). As well, interventions from health care organizations, such as managed care organizations, could be envisioned to promote patients' autonomy, as was done in Seattle, Washington, in a self-help smoking cessation program that led to improvements in sustained cessation (26).

The concept of autonomy support has at times been misconstrued within the medical community as suggesting that patients should be given freedom to make their own medical decisions, with little or no advice from providers. Providers' supporting a patient's autonomy does not mean being detached or withholding advice but instead means actively engaging the patients, understanding their perspectives and feelings, and providing treatment options (along with relevant information such as the likelihood of success of each option) when appropriate. Autonomy-supportive providers often give advice, but they give it without pressure or demand. Treatment decisions ultimately belong to the patient, so providing information in a way that allows the patient to consider it meaningfully in making decisions appears to lead to better outcomes than does giving advice in controlling or authoritarian ways (27,28).

It is also important to realize that supporting patients' autonomy is particularly relevant for chronic, rather than acute, conditions, because with chronic conditions, patients' relationships, motivations, and behaviors are more likely to influence their health outcomes.

Limitations to the generalizability of the results of this study include the modest sample size, the observational nature of the study, and the self-selected sample. Intervention studies with random assignment of patients will be necessary to establish clear causal relations among the variables in the study. Further, generalizability of the results as a model of health behavior change will require additional studies involving both treatment of other chronic illness, such as hypertension or hypercholesterolemia, and preventive behaviors, such as Pap smears and mammograms, where patients' autonomous motivation and felt competence could be expected to have a meaningful effect on health outcomes.

In conclusion, patients with type 1 and type 2 diabetes who perceived their diabetes care providers as being more autonomy supportive became more autonomously motivated to regulate their diets and exercise patterns, felt more competent in managing their diabetes, and displayed improvements in their blood glucose over a 12-month (as well as the initial 4-month) period.

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