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Continuity of Care, Self-Management Behaviors, and Glucose Control in Patients With Type 2 Diabetes

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BACKGROUND. The influence of continuity of care on outcomes of care for patients with type 2 diabetes is poorly understood.

OBJECTIVE. To examine the relationships between continuity, glucose control, and advancement through stages of change for self-management behaviors.

DESIGN. Prospective cohort study.

SETTING. Five community health centers on the Texas-Mexico border.

SUBJECTS. A random sample of 256 adults, 18 years of age and older with an established diagnosis of type 2 diabetes.

MEASURES. Stage of change for diet and exercise were assessed during two patient interviews, averaging 18.9 months apart. Phlebotomy was performed at each interview to measure glycosolated hemoglobin (HbA_{1C}). Medical records were abstracted for ambulatory care utilization. A continuity score was calculated based on the number of visits and number of providers seen.

RESULTS. Patients who advanced one or more stages of change for diet had higher levels of continuity. As continuity improved, the change in HbA_{1C} was smaller. ($r = -0.25$; $P < 0.001$) This relationship remained significant after controlling for number of visits, months since diagnosis, number of days in the study, duration of diabetes, and advancement in stage of change for diet. Advancement through stage of change for diet explained a significant amount of the variance in the relationship between continuity and HbA_{1C} (t test $= -11.33$; $P < 0.01$).

CONCLUSIONS. Continuity of care with a primary care provider is associated with better glucose control among patients with type 2 diabetes. This relationship appears to be mediated by changes in patient behavior regarding diet.

Key words: Continuity of patient care; diabetes mellitus; self care. (Med Care 2002;40: 137–144)

Approximately 90% of all persons with diabetes in the United States receive their medical care from primary care providers.[1] The Institute of Medicine defines primary care as "the provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practic-

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ing in the context of family and community."[2] Continuity, or the development of a sustained partnership between patient and provider, is known to be associated with favorable health outcomes including fewer hospitalizations and emergency department visits, shorter hospitalizations, higher patient satisfaction, better adherence with prescribed medications, and an increased likelihood of having problems identified by the provider.[3–8] We were able to identify only one published study of the relationship between continuity and glucose control among patients with type 2 diabetes. In this cross-sectional study, diabetic patients with a regular health care provider had significantly lower levels of HbA_{1C} compared with those without a regular source of care.[9] The definition of continuity used in this study was the existence of a regular health care provider. Most commonly, the presence of a regular health care provider is considered an indicator of adequate access to care. It may not necessarily be a valid measure of the development of a sustained relationship with a health care provider over time. Although the importance of continuity in caring for chronic diseases such as diabetes has been discussed for some time, little is known about how a sustained relationship with a primary care provider might influence outcomes for patients with type 2 diabetes over time.

Diabetes management is heavily dependent on self-care behaviors by the patient.[10] One approach that has been influential in addressing patient self-care behavior in other chronic disease processes is the stages of change continuum found in the Transtheoretical model.[11] Studies of alcohol use,[12] smoking cessation,[13] exercise adoption,[14] and dieting[15] suggest that persons advance through 'stages of change' when attempting to change a wide range of health related problem behaviors. Those stages are precontemplation, contemplation, preparation, action, and maintenance. We hypothesize that continuity of care with a provider will be associated with improved glucose control over time, and that this relationship will be mediated by advancement through stages of change for diabetes self-management behaviors, such as diet and exercise.

Materials and Methods

Participants

The study was conducted from 1994 to 1996 at five community health centers (CHC) on the Texas-Mexico border. Eligibility criteria for the patients included adults 18 years of age or older with an established diagnosis of type 2 diabetes mellitus for at least 1 year who had been enrolled at the clinics for 1 year or longer. Patients who met these inclusion criteria were systematically selected from computer-generated eligibility lists of patient census records, taking every 5th to 21st patient, depending on the number of patients eligible in each clinic, to achieve the desired sample size. This study was part of a larger study to evaluate the influence of two different types of physician continuing medical education (CME) on practice behavior and has been described in more detail elsewhere.[16] Providers included physicians and mid-level providers (ie, family nurse practitioners and physician assistants). Although several of the providers had subspecialty training, all were engaged in primary care.

Data Collection

Patients were interviewed twice, at least 1 year apart. This time interval was chosen to allow for adequate time for physician CME to influence practice behavior. Bilingual data collectors interviewed patients in accordance with their stated language preference, using, as needed, parallel Spanish language versions that had been created using recommended translation procedures.[17] Strategies to minimize dropouts from follow-up assessments included up to five attempts to contact patients by phone, a letter to those who were unreachable by phone, home visits to patients who were unable to return to the clinic for assessment, and attempts to reschedule patients who did not keep clinic appointments.

Extensive data were collected during each interview on patient self-management behaviors, knowledge of diabetes, attitudes, diet, health status, and functioning. Abstraction of the medical record for each subject was also accomplished with a record of each ambulatory visit and the assigned provider number for the physician with whom the encounter took place.

Continuity

For each patient we measured continuity among primary care providers within each clinic during the period of time between the baseline

and follow-up interviews. A previously validated continuity index was used to measure continuity.[18] The equation for this index is:

Continuity Score =

$$\frac{1-(\text{No. of ambulatory providers})/(\text{No. of ambulatory visits} + 0.1)}{1-(1/\text{No. of Ambulatory Visits} + 0.1)}$$

This score has a range from 0 (if each visit is to a different provider) to 1.0 (if all visits are to the same provider). We chose this index rather than the more commonly used "usual provider continuity" index because it accounts for the total number of providers seen rather than being a simple ratio of visits to the predominant provider, but it does not overcompensate for the number of providers.[19] Another advantage to this measure of continuity is that it is independent of total number of visits.

Ambulatory care visits were defined as scheduled face-to-face encounters with physicians or mid-level providers (nurse practitioners and physician assistants) at each CHC. Patients were excluded from the analysis if they made fewer than three ambulatory visits because of the difficulty of constructing a stable measure of continuity.

Stages of Change

Stages of change for diet and exercise were determined during each patient interview using an algorithmic approach with a series of questions. This approach has been used and validated in multiple studies of stages of change.[20] Once the stage of change for each behavior was established for the baseline and follow-up interviews, subjects were further classified into two groups according to the type of movement they experienced in stage of change between the baseline and follow-up interviews: (1) those who advanced at least one stage of change; (2) those who did not advance.

Glucose Control

After each interview, a phlebotomy was performed. Metabolic control, or the average blood glucose level during the past 8 to 12 weeks, was assessed by HbA_{1C} assay. Values were determined with a Bio-Rad DIAMAT Fully Automated Glycosylated Hemoglobin Analyzer System using the principles of ion exchange high-performance liquid chromatography. The 95% CI for this method is 4.3% to 6.1%.[21] Glucose control was then defined as the change in HbA_{1C} between the initial and follow-up interviews.

Analysis

The mean continuity scores and change in HbA_{1C} were compared between those who advanced at least one stage of change for diet and exercise and those who did not advance with a *t* test. The Pearson correlation coefficient was used to evaluate the relationships between the continuous variables, including the continuity score and the change in HbA_{1C} level between the initial and follow-up interviews. Next, a regression model was constructed with HbA_{1C} at follow-up as the dependent variable and baseline HbA_{1C}, total number of visits, stage of change advancement for diet (yes/no), number of months since diagnosis of diabetes, and number of days in the study as independent variables.

Finally, a path model was constructed and mediation analysis was used to determine if advancement in stage of change might mediate the relationship between continuity and glucose control. (Fig. 1) One cannot infer causality from such a model, instead, one can only say that the result is or is not consistent with what we would expect to observe if a causal path leading from continuity to stage of change to glucose control were in force. In a regression model where both stage of change and continuity are used as predictors of HbA_{1C} level, we determined if advancement in stage of change fully mediates (eg, explains) or partially mediates the relation between continuity of care and HbA_{1C} levels. This was accomplished by comparing the regression coefficient for continuity of care in this model with the coefficient in the direct effects model (eg, where continuity alone predicts HbA_{1C} level). The degree to which the direct effect changed as a result of entering stage of change in the model is known as the mediation effect. A formal test of the significance of the mediation effect was obtained by calculating the standard error of the mediation effect.[22] The relative magnitude of the mediation effect was also assessed.[23] This allowed us to determine the percentage of variance that stage of change explained in the association between continuity and HbA_{1C} level.

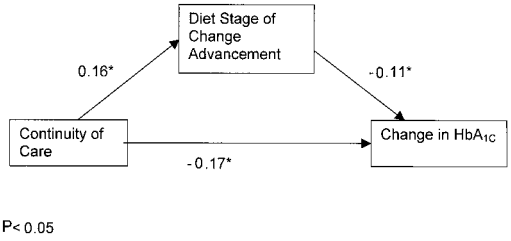

FIG. 1. Path analysis model.

Results

Of the 374 patients recruited to participate in the study, 70 were lost to follow-up. Of the remaining 304 patients, 265 had both a baseline and follow-up HbA_{1C} measurement. A total of 256 subjects had three or more visits and were included in the analysis. Baseline characteristics of the sample are displayed in Table 1. This was a predominantly Hispanic female population with a low level of education. The mean duration between interviews was 18.9 months with a range of 12 months to 23 months. The only significant differences between those with follow-up and those who were lost to follow-up was a higher continuity score among those with follow-up.

Patients were more likely to advance through stages of change for diet (58.4%) than for exercise (34.9%). Patients who advanced one or more stages of change for diet had significantly higher continuity scores than those who did not (Table 2). There was no significant difference in mean continuity scores between those who advanced and those who did not advance for exercise. Although both groups had an increase in their HbA_{1C} between baseline and follow-up, those who failed to advance one or more stages of change for diet had a significantly larger increase in their HbA_{1C} compared with those who did advance. (Table 2) No significant difference was observed in mean change in HbA_{1C} level between those who advanced and those who did not advance for exercise. We also examined a three-level stage of change for diet and exercise: advancement, no change, and relapse. The continuity score was significantly higher for those who advanced for diet compared with those with no change and those with relapse. Those who advanced for diet had a significantly smaller increase in HbA_{1C} compared with those with no change or relapse. There were no significant differences in continuity or HbA_{1C} when exercise was examined as a three-level variable.

As shown in Table 3, the continuity score was inversely correlated with the change in HbA_{1C} in the hypothesized direction ($r = -0.25$; $P < 0.001$). As continuity improved, so did glucose control. Duration of diabetes was also associated with change in HbA_{1C}; as duration increased, there was a smaller change in HbA_{1C} (Table 3). None of the sociodemographic variables had a direct or interactive relationship with the outcome of interest.

The results of the linear regression analysis are displayed in Table 4. The relationship between HbA_{1C} at follow-up and the continuity score was significant after controlling for total number of visits, advancement in stage of change for diet, baseline HbA_{1C} level, number of months since their diabetes was diagnosed, and the number of days between baseline and follow-up interviews during the study. Of interest is the finding that advancement in stage of change for diet was also significantly associated with HbA_{1C} at follow-up in the model. Overall, the model explained 42% of the observed variance in HbA_{1C} at follow-up.

To test the hypothesis that the relationship between continuity and change in HbA_{1C} is mediated by movement in stage of change for diet, a path analysis was constructed (Fig. 1). All the coefficients represented are significant ($P < 0.05$). In the construction of the mediation analysis, advancement in diet stage of change was a significant mediator of the relationship between continuity and change in HbA_{1C}. (t test $= -11.33$; $P < 0.01$) However, advancement for diet stage of change accounted for only 8% of the variance in the association between continuity and HbA_{1C} level.

Discussion

In this prospective study of a cohort of patients with type 2 diabetes, continuity of care was significantly associated with glucose control. This relationship appeared to be independent of duration of diabetes, the length of time of follow-up, and baseline HbA_{1C} level. A small, but significant amount of the relationship between continuity and glucose control is mediated by advancement in stage of change for diet.

Stage of change advancement for diet was associated with continuity and change in HbA_{1C},

TABLE 1. Baseline Characteristics of the Subjects

	Follow-up N = 265	Lost to follow-up N = 70
Age, mean, (SD)	58.7 (9.7)	57.1 (10.4)
Female (%)	71.6	73.1
Education (% HS grad or more)	10.2	5.7
Hispanic (%)	93.1	90.0
Diabetes duration, months, mean, (SD)	109.7 (84.9)	87.8 (72.2)
Months between interviews, mean, (SD)	18.9 (2.64)	n/a
*Continuity Score, mean, (SD)	0.88 (0.16)	.84 (.17)
Change in HbA_{1C}, mean, (SD); range	0.30 (1.68); −7.3, 7.6	n/a
Stages of Change at Baseline:		
Diet (%)		
Precontemplation	31.3	20.3
Contemplation	7.8	5.8
Preparation	34.4	50.7
Action	3.1	5.8
Maintenance	23.5	17.4
Exercise (%)		
Precontemplation	34.2	32.9
Contemplation	7.6	4.3
Preparation	16.4	20.0
Action	11.8	17.1
Maintenance	29.9	25.7

*$P < 0.05$, all other tests for significance failed to reject the null hypothesis.

but exercise stage of change advancement was not. This may reflect the historic emphasis on diet as the key self-management strategy for patients with type 2 diabetes. In a study of patient recall of physician recommendations, more than 80% of patients reported that their physician recommended diet changes, 73.5% remembered physician recommendations regarding exercise, whereas only 69.4% recalled physician recommendations to monitor their blood sugar.[24]

Why should continuity be associated with advancement in stages of change for diet and glucose control in patients with type 2 diabetes? Development of a sustained relationship may influence both patient and physician behaviors in a manner that would improve self-care behaviors and glucose control. From the patient's perspective, this sustained relationship may improve their sense of trust in their physician. As trust improves, patients may be more comfortable in divulging critical

TABLE 2. Stage of Change Movement, Continuity Score, and Change in HbA_{1C}

	Diet		Exercise	
Type of Movement	Continuity Score*	HbA_{1C} Change†	Continuity Score‡	HbA_{1C} Change‡
Advance	0.91 (0.12)	0.06 (1.74)	0.87 (0.14)	0.35 (1.40)
Did not Advance	0.86 (0.17)	0.67 (1.59)	0.89 (0.15)	0.28 (1.82)

*$t = -2.45$, $P = 0.015$.
†$t = 2.80$, $P = 0.005$.
‡not significant ($P > 0.05$).

TABLE 3. Correlations: Pearson *r*

	Change in HbA1c (*P*)	Total Visits (*P*)	Duration of Diabetes (*P*)	No. of Days in Study (*P*)
Continuity score	−0.254 (0.001)	0.320 (0.001)	0.038 (0.531)	0.268 (0.001)
Change in HbA1c		−0.063 (0.317)	−0.175 (0.007)	−0.112 (0.076)
Total visits			0.209 (0.001)	−0.107 (0.067)
Duration of diabetes				−0.068 (0.269)

information regarding their social context that is relevant to their health. This information may improve physician decision-making concerning management. For example, patients who reported a forced change in physician caused by changes in their health insurance plan rated their interpersonal communication with their physician and the accumulated knowledge of their physician significantly lower than those who did not experience such a disruption in continuity.[25] Improved patient trust may also make them more willing to follow physician recommendations concerning self-management behaviors. In a recent study comparing continuity of care in the United States and Great Britain, investigators found that trust was related to length of time in the relationship with their current physician.[26]

In like manner, a continuity relationship may allow physicians to become more sensitive to subtle cues that help them elucidate and understand the nature of a patient's problems. In a recent study comparing physician practice styles during initial and return patient visits, the content of the encounter changed dramatically.[28] Return visits displayed less technically oriented behavior, such as history taking. Instead, there was much more emphasis on health behaviors and active involvement of patients in their own health care, including answering patient questions and activities that might enhance change processes by the patient.

Although stage of change for diet was a significant mediator of the relationship between continuity and glucose control, it explained only 8% of the variance in the relationship. It is possible that continuity contributes toward other aspects of patient care besides supporting advancement for self-management behaviors. Providers who are more familiar with each patient as a result of continuity may be more comfortable making changes in their medication regimen that result in improved glucose control. It is also possible that continuity may improve patient adherence with their medication as a result of improved trust in the provider. However, when we examined self-reported medication adherence, it was not associated with continuity or glucose control.

Several limitations of this study deserve mention. First, 31% of patients with a baseline interview were either lost to follow-up, did not have both baseline and follow-up HbA_{1C} measurements, or had fewer than three visits and were not included in the analysis. The direction of potential bias introduced by this drop-out rate cannot be easily predicted. One would assume that those who could not be relocated

TABLE 4. Continuity and Glucose Control: Regression Results

	Unstandardized Coefficients	SE	Standardized Coefficients	t	*P*
Continuity score	−1.98	0.64	−0.17	−3.08	0.002
Total number of visits	−0.01	0.02	0.03	0.47	0.64
Diet stage of change advance	−0.445	0.20	−0.11	−2.23	0.03
Baseline HbA_{1C}	0.68	0.06	0.64	12.23	0.001
Duration of diabetes	−0.001	0.001	−0.05	−0.91	0.36
Number of days in study	−0.001	0.001	−0.05	−1.04	0.30

Dependent Variable: HbA_{1C} at Follow-Up
Model Statistics: $F = 29.04$, $P < 0.001$, Adjusted $R^2 = 0.42$.

were more likely to have lower continuity scores, decreasing the spectrum of continuity scores on the lowest end. Yet it seems unlikely that these same patients are more likely to have improved their HbA_{1C} on their own, which would have to be the case to reduce the influence of continuity on HbA_{1C}. In addition, as shown on Table 1, the only significant difference between those lost to follow-up and those completing the second interview was their continuity score.

Second, self-reported behaviors may not represent actual behaviors. That is, as patients learned the nature of appropriate self-management behaviors over time, they may have been more likely to give answers to interview questions regarding stages of change for self-care behaviors that they think the interviewer would like to hear. This type of bias may have been more likely to occur in those whose diabetes is not as well controlled, for example, those who are not managing their diabetes well are more likely to have worse control, yet report that they are adhering to their diet. However, this source of bias should weaken the relationship between stage of change for diet and glucose control, not falsely strengthen it.

Even with our prospective study design, our findings support, but are not definitive about, a causal relationship between continuity of care and glucose control among patients with type 2 diabetes. It is possible that there are unmeasured factors, such as patient personality characteristics, that both lead to continuity of relationship with provider and better self-management behaviors. It is also important to note that with this is a predominant Hispanic sample. The fundamentally allocentric nature and familial orientation of this culture suggest that social networks and contexts of care might also be important in explaining glucose control.

The issue of maintaining a continuity relationship with a provider is much a contemporary issue. Current changes in the financing and organization of health care create significant threats to a sustained relationship between a provider and a patient.[28,29] In a study of new members of one health maintenance organization, 41% had switched providers.[30] In recent reports from the Community Tracking Survey, 13% of people with a usual source of care changed providers in the prior year, and 60% of those did so involuntarily because of changes in their insurance, their provider moved, retired, or died, or they moved.[31] Recent reports from the Medical Expenditure Panel Survey suggest that insurance-related reasons are the second most common reason for a change in usual provider in the United States.[32]

Much remains to be known about the importance of continuity of care with a provider for patients with type 2 diabetes. The relationship between continuity and self-management behaviors needs to be elucidated. Current limitations in our understanding of primary care practices and a lack of real world laboratories must be overcome to advance our understanding of how and when primary care physicians address self-management strategies, the content of the advice that is provided, the feasibility of incorporating effective self-management advice into the competing demands of primary care practice, and the effectiveness of such advice on patient behavior and outcomes.

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