Personal Models for Diabetes in Context and Patients' Health Status

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In a diverse sample of 452 adult diabetes patients, we investigated: (1) personal model dimensions for diabetes and expanded upon the literature by indexing fatalism, (2) the relationship between contextual factors and patients' beliefs about the seriousness and controllability of diabetes, and (3) the unique contribution of illness representation combinations to clinical outcomes when controlling for baseline disease severity. Major categories of predictors included patients' sociocultural characteristics, illness history (e.g., co-morbidities, diabetes complications) and recent physical symptoms. Illness representations were measured using the Personal Models of Diabetes Interview and questions that index fatalistic beliefs. Clinical outcome measures included patients' glycemic control (HbA1c) and the patient's physical and mental functions as measured by the SF-12. Analyses corroborated the literature by identifying *seriousness* and *treatment effectiveness* cognitive model dimensions for diabetes. Physical symptoms and other disease-related factors were strong predictors of patients' seriousness beliefs for diabetes, whereas sociocultural factors (education, ethnicity) best explained representations related to the controllability of diabetes (i.e., treatment effectiveness, fatalism). Seriousness beliefs were good indicators of actual glucose control, except for cases in which patients were more fatalistic and believed diabetes to be less serious. Although patients had medically consistent views of their diabetes, variations in personal models of diabetes were related to specific contextual factors and independently explained diabetes control.

KEY WORDS: diabetes mellitus; illness representations; personal models; sociocultural factors; health status; fatalism.

Research indicates that chronically-ill patients' beliefs about their illness predict self-care behaviors and outcomes (Hampson, 1997; Meyer *et al.*, 1985; Petrie *et al.*, 1996; Scharloo and Kaptein, 1997). These individualized cognitive belief systems, called *illness representations* (Leventhal and Diefenback, 1991; Leventhal *et al.*, 1984) and *personal model*s (include emotional representations of illness; Hampson

et al., 1995; Hampson *et al.*, 1990), serve as "common-sense" frameworks for interpreting symptoms and engaging in behaviors to manage conditions of poor health (Meyer *et al.*, 1985; See Fig. 1). Patients use illness representations to interpret bodily symptoms, guide decisions on how best to respond to somatic experiences, and evaluate the effectiveness of changes in their medical management or self-care. Potential discrepancies between the patient and provider view of illness can explain why apparently "irrational" behavior to the clinician is completely rational given the patient's understanding of his or her disease (Murphy and Kinmonth, 1995). Regardless of these different perspectives on illness, an assumption of the self-regulation theory is that patients are motivated to protect themselves from health dangers, and this goal is consistent with the motivation of their clinician.

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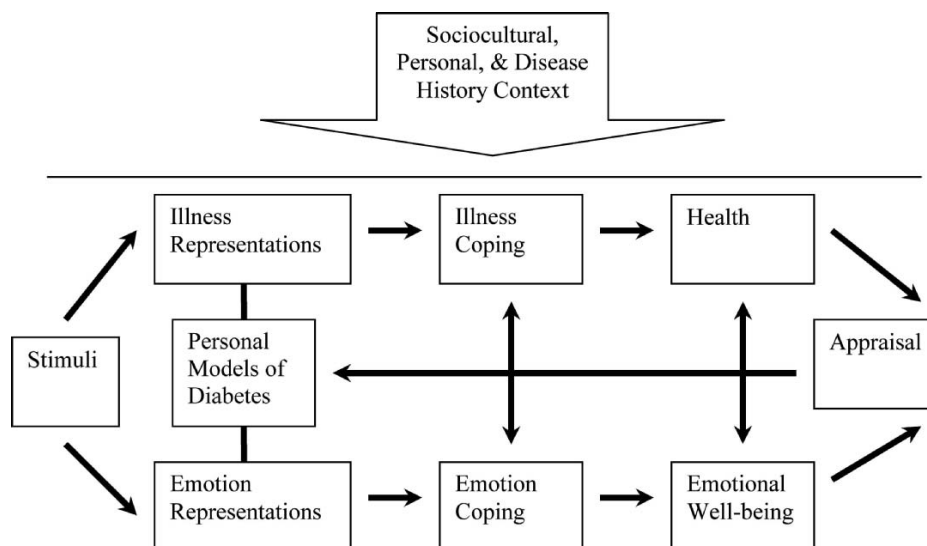
Fig. 1. Self-regulation model for diabetes (sources: Edgar and Skinner, 2003; Leventhal *et al.*, 2001; Leventhal *et al.*, 1980.)

Personal Models of Diabetes

Empirical investigation suggests that patients in the United States and England tend to have views of diabetes that are consistent with traditional Western medical models of disease and that most patients agree about the causes (e.g., genetics, diet) and trajectory (i.e., chronic illness) of the illness (Hampson, 1997; Hampson *et al.*, 1995). Hampson and colleagues (Hampson *et al.*, 1990; Hampson *et al.*, 1995) identified two important cognitive dimensions in their comprehensive studies of patient-defined (Leventhal and Nerenz, 1985) representations of diabetes: Seriousness and Treatment Effectiveness. The seriousness dimension represents patients' beliefs and concerns regarding the influence of diabetes on their life expectancy, health-related quality of life, and daily functioning. The treatment effectiveness dimension comprises patients' beliefs about the impact of self-care regimens on the control of diabetes and about following standard treatment regimens.

The seriousness dimension of personal models has theoretical overlap with the disease severity component of the Health Belief Model, and treatment effectiveness is related to concepts of perceived control (Hampson, 1997). Another construct that is under the disease controllability umbrella is fatalism, which is important to consider in efforts to improve self-care behavior especially within the Latino/Hispanic population (Antshel, 2002). In diabetes, some re-

search has identified a medically consistent view of diabetes among Latinos (Weller *et al.*, 1999; Weller and Baer, 2001) and other research indicates some degree of fatalism regarding the course of diabetes in Mexican Americans and Carribean Latinos (Schwab *et al.*, 1994; Quatromoni *et al.*, 1994). In the current study, we investigated whether Seriousness and Treatment Effectiveness dimensions could be empirically identified in a multiethnic group of patients, and additionally explored fatalism beliefs and systematic variations in diabetes illness representations associated with contextual and health factors.

Factors that Influence Personal Models of Diabetes

According to self-regulation theory, concrete sensations (i.e., symptoms), patient characteristics (e.g., personality dispositions), disease history, and sociocultural influences, play a role in the formulation of illness representations (Diefenbach and Leventhal, 1996; Leventhal *et al.*, 1984; Leventhal *et al.*, 2001). Contextual factors are usually represented in graphical representations of the self-regulation theory by broad stroke arrows (see Fig. 1). However, certain dimensions of personal models of illness may be differentially affected by varying contextual factors and empirical work is needed to uncover intricacies of this relationship.

Prior experiences with diabetes can generate memories that influence the representation of that

illness and the interpretation of future disease states. Therefore, past complications, glucose control and other disease-related experiences may influence beliefs regarding the seriousness of diabetes. People tend to believe that symptoms accompany illness, and more intense symptoms indicate more intense illness (Leventhal *et al.*, 1980). Thus, diabetes patients who have had complications and symptoms from their illness may believe diabetes to be a more severe condition than patients who have had few symptoms or complications. Research on over 600 diabetic patients showed that patients use symptoms as a primary part of their assessments of their personal health and diabetes control (Lange and Piette, 2005). Although symptoms are important determinants of diabetes patients' beliefs about the seriousness of their illness, one study found that type 2 patients taking insulin reported lower levels of symptoms yet rated their diabetes to be *more* serious than those not taking insulin (Hampson *et al.*, 1990). Therefore, other factors than symptoms appear to contribute to the development of severity beliefs. The current study investigates associations between disease and socio-demographic variables and patients' seriousness beliefs for diabetes.

Treatment Effectiveness models have been found in prior studies to be predictive of self-management behaviors (Glasgow *et al.*, 1997; Skinner *et al.*, 2000). Some empirical work suggests that treatment effectiveness beliefs may be influenced by sociocultural factors such as age (Hampson *et al.*, 1990), yet other patient characteristics (e.g., education level, self-reported health, comorbidities) are usually unrelated to beliefs about treatment effectiveness.

In sum, a variety of factors, including various socio-demographic and clinical characteristics, may influence personal models for diabetes (Baumann, 2003; Hampson *et al.*, 1990). More work is needed, however, to investigate a broader base of potential factors that may play a role in the development of illness representations and delineate what illness representation attributes are most susceptible to various somatic, personal, and cultural influences (Leventhal *et al.*, 1997; Diefenbach and Leventhal, 1996). In addition, there is a call for exploration into how illness dimensions may interact in determining diabetes control and whether combinations of illness representation predict health outcomes beyond disease severity (Lau, 1997; Adrian *et al.*, 2003).

The goals of the study were threefold. First, a major aim of the current study was to assess contributions of contextual and disease factors to various illness representation domains in a sociodemographically diverse sample of patients with diabetes. Second, the investigation expanded on the illness representation literature by assessing fatalism as a potentially important construct to consider, especially in some ethnic groups. Finally, the study advances past research by addressing a call to explore illness representation combinations in explaining clinical outcomes (e.g., HbA1c).

METHODS

Participants and Enrollment

Data were collected from adult patients with diabetes using hypoglycemic medication (oral agents and/or insulin) who were participating in a study to evaluate the prognostic significance of patients' automated telephone assessments (Piette *et al.*, 2003). The study was purely observational and no additional health services were provided to participants. Approximately 1200 patients were identified via electronic appointment lists as eligible for participation during outpatient primary care visits to health systems in the United States, including three Department of Veterans Affairs (VA) health care systems, one county health care system, and one university-based health care system. Patients interviewed by trained research assistants were eligible for participation if they were over 21 years of age, spoke English or Spanish as their primary language, and had a permanent residence and a working telephone. Patients excluded from participation had a life threatening physical illness (e.g., cancer, HIV, renal failure) or serious mental disorder (e.g., schizophrenia, dementia), were visually or hearing impaired, or planned to change health care systems in the upcoming year. Of the eligible patients, 848 (70%) completed the baseline telephone survey. Telephone interviewers were fluent in Spanish and English. All participants provided informed consent and the study was approved by Institutional Review Boards at each site.

Clinical HbA1c was collected in clinic at enrollment and patients were contacted via telephone for the baseline interview. Surveys were mailed at 6 and 9 months following enrollment to index illness representations and HbA1c was again collected at 6-month follow-up in clinic. A total of 452 patients

completed personal models of diabetes measures as part of mailed follow-up surveys conducted at 6 and 9 months after their enrollment. The study was offered in English or Spanish, with 29 completing the study in Spanish. Standard procedures for Spanish translation of measures (Brislin *et al.*, 1973; Piette *et al.*, 2000) were employed; specifically, questions were translated into Spanish and back-translated to English with discrepancies addressed and rectified. Missing follow-up data were not related to participants' education level, insulin use, gender, time since diabetes diagnosis, or type of diabetes (type 1 or type 2). Patients in the VA system of care (61.5%) were more likely to complete the surveys than patients in the community-based (44.8%) and private university-based (47.1%) clinics ($p < .001$). The sample in the current study also was slightly older ($M = 60.3$, $SD = 11.01$) than the baseline participants without follow-up data ($M = 57.21$, $SD = 57.21$; $p < .001$). Hispanic/Latino participants and those labeled as "multiple/other racial identification" were less likely to complete the illness representation measures than patients in other ethnic and racial categories ($p < .001$). In addition, patients whose primary language was Spanish were less likely to complete personal models of diabetes measures (40.6%) than those speaking English (54.1%; $p = .05$).

Measures

The current study examined the following predictors of personal beliefs for diabetes: sociocultural contextual factors and disease factors including recent physical symptoms and illness history factors such as comorbidities, diabetes complications, and years since diabetes diagnosis. Contextual and health history variables were collected during a detailed telephone interview at the time of enrollment. Personal beliefs for diabetes were collected in mailed paper-and-pencil surveys at 6- and 9-month follow-up periods. The SF-12 and symptom checklist were included in the 6-month mailed survey. Clinical data (i.e., HbA1c) were collected in clinic during enrollment and again at 6 months.

Personal Models of Diabetes

Personal beliefs about diabetes were assessed utilizing questions developed from the Personal

Models of Diabetes Interview (Hampson *et al.*, 1990; Glasgow *et al.*, 1995; Hampson *et al.*, 1995). Participants answered seven self-report questions regarding personal beliefs for diabetes (e.g., how serious is your diabetes?) on a scale of 1 (not at all) to 5 (extremely). Questions addressed personal models for treatment effectiveness and the seriousness of diabetes and were administered at 6- and 9-month assessment periods.

To index beliefs related to fatalism for diabetes, patients indicated agreement (1: strongly disagree; 5: strongly agree) with two statements that their illness is largely dependent on chance or fate and that there is very little they can do to personally improve their diabetes-related health status. Answers to these statements were averaged to create a Fatalism scale and had a reliability (Cronbach's α) of .77 at 6-month and .72 at 9-month measurement with a test–retest reliability of .68.

Sociocultural Contextual Factors

Sociocultural factors were measured during the enrollment survey and included patients' ethnicity or race, age, sex, income level, education level, marital/relationship status, having a primary health care provider, taking a diabetes education class in the past year, and health care system type (VA, county, university-based). As part of the baseline telephone interview, participants were asked to identify the ethnic group category that best described them: (a) Asian or Pacific Islander, (b) Black or African American, (c) Latino or Hispanic, (d) White, (e) multiethnic, or other (specified).

Disease Context

Measures of disease severity included self-reported years since diabetes was first diagnosed, diabetes type (type 1, type 2), presence of diabetes complications such as neuropathy and retinopathy, the use of insulin, and co-morbid chronic conditions. Co-morbidities were assessed by patients selecting conditions from a list developed by clinicians for use in previous studies (Lange and Piette, 2005). Self-reported diagnoses were used rather than medical record diagnoses to better reflect patient perceptions and to obtain a more complete enumeration of conditions than is possible through a medical record review over a limited period of time (i.e., past 12 months).

Diabetes-Related Physical Symptoms

A diabetes symptom index was calculated as a sum of patients' reports of 20 symptoms over the prior week. The symptom list was created by clinicians to index symptoms of hyperglycemia and hypoglycemia, in addition to other diabetes-related symptoms (e.g., microvascular), and has been utilized in previous studies (Lange and Piette, 2005).

Clinical and Health Outcomes

Patient's glycemic control was measured using the glycosylated hemoglobin (HbA1c) blood test, which reflects glycemic control over the previous 2 to 3 months (American Diabetes Association, 1999). In general, the American Diabetes Association recommends an HbA1c level below 7% as blood sugar control is essential to avoiding complications from diabetes. HbA1c tests were conducted in clinic by trained research staff using fingerstick capillary blood samples and the DCA 2000 Analyzer (Arsie *et al.*, 2000).

General physical and mental health was measured using the SF-12 Health Survey Physical and Mental Component summary measures (Ware *et al.*, 1995; Gandek *et al.*, 1998). The SF-12 has proven to be a reliable (test–retest reliability correlations of 0.89 for the Physical Component Summary and 0.76 for the Mental Component Summary) and valid scale, with high correspondence with the original SF-36 (Physical $R^2 = .91$; Mental $R^2 = .94$; Ware *et al.*, 1996).

Statistical Analyses

Factor analysis using Varimax rotation was conducted to identify personal model dimensions for diabetes at 6 months, and confirmatory factor analysis was performed on 9-month illness representation data to verify personal model factor structures.

Bivariate and multivariate analyses were conducted to assess the association between contextual and disease factors and patients' diabetes-related illness representations at 6 months. Hierarchical linear regression analyses were used to predict illness representations based on sociocultural factors (i.e., ethnicity, system of care, committed relationship, income, education level, gender, having a primary care provider, diabetes education class in the past

year, and age), illness history (i.e., diabetes type, insulin use, diabetes complications, co-morbidities, and baseline HbA1c, and diabetes diagnosis years), and diabetes-related physical symptoms.

In the final phase of the analyses, bivariate correlations and multivariate regression analyses were conducted to determine whether illness representations (6 month) accounted for disease outcome (i.e., HbA1c at 6 months) significantly beyond disease severity. Furthermore, interaction terms were entered into the hierarchical linear regression model to investigate potential combinations of personal models that may influence glucose control in diabetes.

RESULTS

Sample Description and Health

The sample of 452 patients analyzed in the current study was socio-demographically diverse with 17.7% ($n = 80$) of the sample Black/African American, 11.1% Hispanic/Latino ($n = 50$), 11.5% Asian/Pacific Islander ($n = 52$), 3.8% Other or Multiple Ethnicities ($n = 17$), and 55.5% White/Caucasian ($n = 251$). Over half were male (69.7%), college educated (59.5%), currently married or in a committed relationship (58.4%), reported English as their primary language (94%; 6% Spanish), had been diagnosed with diabetes less than 10 years ago (55.1%), and reported a diagnosis of Type 2 diabetes (76.8%). A large proportion of the sample was low income with 45.8% of the sample reporting a gross annual income of $20 K or less.

The average HbA1c of the sample was 7.86% (SD = 1.66) at baseline and 7.43% (SD = 1.39) at the 6-month follow-up. HbA1c levels at the 6-month follow-up were associated with age ($r = -.13$, $p < .05$), health care site [$F(2,367) = 10.69$, $p < .001$], and ethnicity [$F(4,364) = 5.73$, $p < .001$]. Specifically, VA patients had lower HbA1c levels (7.15%, SD = 1.15) than patients from the community ($M = 7.68\%$, SD = 1.45) and private health care systems ($M = 7.88\%$, SD = 1.66). Latino ($M = 8.04\%$, SD = 1.61) and patients who categorized themselves as "multiple/other" ($M = 8.67\%$, SD = 1.68) had higher HbA1c values than did white patients ($M = 7.25\%$, SD = 1.20). Six -month HbA1c was not associated with education level, relationship status, or economic status. Patients with type 1 diabetes had higher HbA1c levels ($M = 7.86\%$, SD = 1.61) than

patients with type 2 diabetes [$M = 7.36\%$, SD $= 1.34$; $F(1, 316) = 3.9$, $p < .05$]. The average SF-12 physical and mental component summary scores for the sample were 40.96 (SD $= 12.03$) and 45.54 (SD $= 10.72$), respectively. A majority of the sample reported a diagnosis of hypertension ($n = 343$, 75.9%) and/or high cholesterol ($n = 287$, 63.5%). Over half of the sample reported arthritis or rheumatism ($n = 229$, 50.7%) and 33.2% ($n = 150$) reported having asthma or allergies. Over a quarter of the sample reported arteriosclerosis or angina ($n = 122$, 27.0%) and 21.2% ($n = 96$) of the sample reported having had a heart attack. Self-reported cases of emphysema, congestive heart failure, stomach ulcers cancer, kidney trouble, and stroke all were all below 15% for the sample. Diabetic complications of neuropathy ($n = 140$, 31%) and retinopathy ($n = 89$, 19.7%) were present in the sample.

Cognitive Representations for Diabetes

Questions from the Personal Models of Diabetes Interview were factor analyzed in the current study, revealing two consistent scales for both measurement periods (6 and 9 month). Factor 1 comprised 41.64% (Eigenvalue $= 2.50$) of the variance at 6 months and 40.81% at 9 months (Eigenvalue $= 2.45$) and corresponded directly to the personal model category Seriousness (time-line and consequences), identified by Hampson *et al.* (1990, 1995). Three items loading highly into the Seriousness factor were ratings of the seriousness of diabetes, worries about developing diabetes complications, and the impact of diabetes on activities (Cronbach's $\alpha = .75$ at 6 month and .76 at 9-month; test–retest reliability of .71).

The two items loading highly on Factor 2 included beliefs about treatment effectiveness in controlling diabetes and avoiding complications and comprised a reliable scale (Cronbach's $\alpha = .80$ at 6 month and .84 at 9 month; test–retest reliability of .59). This also was consistent with results reported by Hampson *et al.* (1990, 1995) and we utilized their terminology for Factor 2, Treatment Effectiveness. Treatment Effectiveness accounted for 23.65% of the variance at 6 month (Eigenvalue $= 1.42$) and 27.65% of the variance at 9 month (Eigenvalue $= 1.66$). In line with factors identified at 6 months and confirmed at 9 months, data were averaged into two subscales: Seriousness and Treatment Effectiveness.

Higher scores on these subscales represent greater endorsement of beliefs that, respectively, diabetes is a serious condition and that treatment is important for controlling diabetes. Correlations between illness representation dimensions at 6- and 9-month measurement periods revealed high consistency for Seriousness [$r(441) = .714$, $p < .001$], Fatalism [$r(449) = .695$, $p < .001$] and Treatment Effectiveness [$r(440) = .593$, $p < .001$] across the two measurement periods. Given that the 9-month assessment was confirmatory in nature for identifying facture structures, we focused on the 6-month illness belief data in further analyses as this corresponded best with 6-month clinical measures of HbA1c and health functioning.

The average ratings on the Serious dimension of personal models for diabetes was 3.03 (out of maximum of 5.0; SD $= .94$). A majority (70.1%) of the sample rated their diabetes from moderately to extremely serious with a lower, yet notable, percentage rating their diabetes as "slightly" or "not at all" serious (29.9%). A median of 4.00 on a 5.0 scale for Treatment Effectiveness at ($M = 4.03$; SD $= .95$) showed that the majority of the sample (70.6%) rated diabetes treatment as "very" or "extremely" important in controlling diabetes and preventing complications. The sample was, overall, low on fatalism for their diabetes, with a median of 2.00 ($M = 2.27$, SD $= 1.03$) on a scale of 1 (strongly disagree) to 5 (strongly agree).

Cognitive Beliefs Bivariate Relationships

Results of analyses investigating the association of diabetes models with categorical contextual and health variables are summarized in Table I.

Seriousness

Although only 17 patients were included in multiple or other ethnic categories, these patients did rate their diabetes as more serious than Latino/Hispanic and Asian patients, $F(4, 445) = 3.42$, $p < .01$. Seriousness ratings were not related to system of care, education level, household income, sex, or relationship status. Type 1 patients reported beliefs that their diabetes was more serious than did Type 2 patients, $F(1, 384) = 4.06$, $p < .05$. Age was negatively correlated with Seriousness scale scores [$r(452) = -.20$, $p < .001$] and patients with a diagnosis of diabetes for 10 years or more rated their diabetes to be more serious than those whose diabetes had been diagnosed

Table I. Average Seriousness, Treatment Effectiveness and Fatalism Beliefs for Diabetes by Sociodemographic and Health Variables

| | | Personal models for diabetes control | | | | | |
| | | Seriousness | | Treatment effectiveness | | Fatalism | |
Variable	n	M	SD	M	SD	M	SD
Ethnicity							
White	251	3.09	.91	4.11[a]	.90	2.10[a]	.89
Black	80	3.07	.97	4.03	1.03	2.26[a]	1.06
Latino	50	2.84[a]	.98	3.62[b]	.97	3.03[b]	1.21
Asian	52	2.75[a]	.93	4.10	.93	2.40[a]	1.12
Other/multiple	17	3.57[b]	.94	4.04	.86	2.41	1.08
System of care							
VA	222	3.09	.96	4.08[a]	.92	2.16[a]	.92
Community	91	3.02	.96	3.74[b]	.93	2.79[b]	1.18
Private	139	2.94	.89	4.14[a]	.97	2.11[a]	1.00
Education							
Less than HS	77	2.93	1.00	3.71[a]	.98	2.93[a]	1.12
HS diploma	104	2.98	1.01	3.80[a]	.99	2.48[b]	1.01
Some college	148	3.14	.88	4.11[b]	.90	2.14[c]	.91
College degree	121	3.02	.94	4.36[c]	.80	1.85[d]	.86
Household income							
<$10 K	95	3.07	.97	3.95	.98	2.55[a]	1.06
$10 K–$20 K	112	3.08	1.00	4.03	.88	2.30[a]	.96
>$20 K	196	2.99	.90	4.13	.95	1.97[b]	.93
Sex							
Male	315	3.12	.96	4.04	.96	2.22	.99
Female	137	3.05	.89	4.02	.94	2.39	1.13
Committed relationship							
Yes	264	3.04	.94	4.05	.96	2.24	.99
No	185	3.03	.94	4.00	.95	2.33	1.09
Diabetes							
Type 1	39	3.36[a]	.88	4.40[a]	.58	2.10	1.11
Type 2	347	3.05[b]	.91	4.11[b]	.87	2.21	.98
Diagnosed years							
Less than 10 years	249	2.94[a]	.95	3.97	.95	2.27	.96
10 years or more	201	3.16[b]	.91	4.12	.92	2.28	1.11
Insulin							
No	287	2.89[a]	.93	3.97	.97	2.26	1.01
Yes	164	3.28[b]	.90	4.14	.91	2.29	1.08

Note. Higher values represent greater endorsement of illness belief dimensions. Means with a different superscript are significantly different at $p < .05$.

for less than 10 years, $F(1, 448) = 6.16$, $p < .05$. Patients using insulin to control their diabetes rated their diabetes as more serious than patients using oral hypoglycemics only [$F(1, 449) = 18.70$, $p < .001$].

Health and symptom indices were significantly correlated with Seriousness ratings. Patients who reported more diabetes complications [$r(452) = .32$, $p < .001$], co-morbidities [$r(452) = .33$, $p < .001$], baseline symptoms [$r(452) = .40$, $p < .001$], and recent symptoms [$r(452) = .46$, $p < .001$] had higher scores on the Seriousness scale of the Personal Models of Diabetes Interview.

Treatment Effectiveness

White participants reported greater beliefs in treatment effectiveness than Hispanic/Latino participants, $F(4, 444) = 2.83$, $p < .05$, and patients from the county health care system reported lower treatment effectiveness beliefs than VA and private health care system patients, $F(2, 448) = 5.63$, $p < .01$. Patients with at least some college education rated diabetes treatment as more important than patients with no college education, and those with a college degree reported the greatest confidence in treatment effectiveness for controlling their diabetes,

$F(3, 445) = 11.08$, $p < .001$. Ratings of treatment effectiveness were not significantly associated with household income, sex, relationship status, years with diagnosed diabetes, and insulin use (Refer to Table I). Patients with type 1 diabetes reported more belief in treatment effectiveness than type 2 patients [$F(1, 383) = 4.03, p < .05$]. Age was inversely related to beliefs about treatment effectiveness $r(451) = -.131$, $p < .01$.

Treatment Effectiveness scores on the Personal Models of Diabetes Interview were not associated with health indices.

Fatalism

Hispanic/Latino patients reported a higher level of fatalism than White, Black, and Asian patients [$F(4, 443) = 9.22, p < .001$]. Patients in the county health care system reported a greater degree of fatalism than patients at the VA and university-based systems of care [$F(2, 447) = 15.28, p < .001$]. The higher the education, the lower the degree of fatalism, with each educational group level significantly different (college degree, some college, HS diploma/GED, and less than high school degree), $F(3, 444) = 22.27$, $p < .001$. Patients with an annual household income of more than \$20,000 were less fatalistic and reported more personal control over diabetes than patients in a lower income bracket $F(2, 398) = 11.72, p < .001$. Fatalistic beliefs about diabetes control were not associated with age, relationship status, diabetes type, diagnosed years, or insulin use (See Table I).

Fatalistic beliefs for diabetes were positively correlated with baseline [$r(452) = .21, p < .001$] and recent [$r(452) = .21, p < .001$] symptom reports. A greater number of co-morbidities [$r(452) = .14, p < .01$] was associated with higher levels of fatalism.

Multivariate Analyses

Table II presents intercorrelations between contextual and disease predictor variables. The strongest correlations, although none were greater than .53, were between system of care and sex and system of care and ethnicity. These correlations were driven by the fact that the VA sample was primarily male (95.9%) and white (82.4%), whereas the other samples were more diverse on these dimensions. Comorbidities were positively related to diabetes complications and all other coefficients

between predictors were below .37. Investigation of Eigenvalues, variance inflation factors (VIF) with variance proportions did not reveal multicollinearity problems in further regression models. In addition, examination of residual scatterplots did not reveal considerable violations of normality, however, treatment effectiveness and fatalism scores were negatively and positively skewed, respectively.

As shown in Table III, the strongest predictor of seriousness ratings for diabetes was recent symptoms. Beliefs about the seriousness of one's diabetes also was associated with higher baseline HbA1c and a greater number of diabetes complications and comorbidities. Overall, it appears that patients rely heavily on current symptoms as well as other illness indicators in determining the severity of their diabetes. Sociocultural factors explained only 8.4% of the variance in Seriousness ratings; whereas, physical health and symptom variables accounted for 25.3% of the variance, for a total model R^2 of 33.6% ($p < .001$).

Education level was the strongest predictor of treatment effectiveness beliefs, when controlling for other sociocultural and health-related factors. Specifically, the higher the education, the greater patients' belief in the importance of treatment for controlling their diabetes. The total model explained only 11.7% of the variance in beliefs for treatment effectiveness, and disease and physical symptom variables added little to the predictive power of the model ($\Delta R^2 = .008, p > .10$).

Education level was a robust predictor of fatalism beliefs for diabetes, with higher education related to lower levels of fatalistic beliefs. In addition, patients earning a lower annual income reported higher fatalism, and Hispanic/Latino patients were more fatalistic overall than patients in other ethnic categories. Taking at least one diabetes education class in the past year was related to lower fatalism for diabetes. Overall, sociocultural contextual factors explained the majority of the variance in the models (21.1% Step 1), with the addition of health and symptom variables contributing 2.6%, for a total R^2 of 23.6%.

Illness Representations and Health Outcomes

Treatment effectiveness beliefs were not significantly related to baseline and follow-up clinical outcome measures (i.e., HbA1c, Physical and

Table II. Correlations Between Predictor Variables for Diabetes Illness Beliefs

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Ethnicity															
2. System of care	.43***														
3. No committed relationship	.03	.15**													
4. Income	−.05	.07	−.31***												
5. Higher education	.02	.14**	−.06	.34***											
6. Female	.28**	.52***	.22***	−.03	−.03										
7. Age (in years)	−.13**	−.18**	−.08	−.05	−.23**	−.17**									
8. No primary care provider	−.01	−.01	−.04	−.05	−.04	−.02	.04								
9. Diabetes class (past 12 months)	.04	.13**	−.01	−.01	.07	.07	.01	.03							
10. Diabetes Type (2 Vs. 1)	.04	−.23**	.01	−.12*	−.15**	−.09	.37**	−.08	−.01						
11. Baseline HbA1c	.11*	.16**	.08	−.04	−.12**	.14**	−.10	.03	−.02	−.05					
12. Insulin	−.12*	.00	.02	.05	.01	−.01	−.16	.06	−.08	−.31**	.17**				
13. No. of diabetes complications	−.02	−.02	.09*	−.05	.01	.04	.03	−.08	.05	−.02	.02	.21**			
14. No. of comorbidities	−.15**	−.02	.05	−.09	−.09	−.07	.18**	−.09	.01	.22**	−.09	.07	.49**		
15. Diagnosis years	−.06	.05	.00	.05	.04	−.05	.15*	.08	.05	−.12*	.07	.29**	.20**	.11*	
16. Physical symptoms	−.01	−.10*	.03	−.14**	−.11*	.08	−.01	−.04	−.05	.11*	.01	.03	.22*	.48**	−.02

*p < .05; **p < .01; ***p < .001.

Table III. Summary of Hierarchical Linear Regression Analysis on Sociocultural and Health Variable Predictors of Illness Representation Dimensions

| | Personal models for diabetes control | | | | | |
| | Seriousness | | Treatment effectiveness | | Fatalism | |
Variable	β's	Partial r's	β's	Partial r's	β's	Partial r's
Step 1						
Sociocultural & healthcare context						
Ethnicity	−.02	−.02	.05	−.05	.15**	.15
System of care	.03	−.02	.04	.03	−.05	−.05
No committed relationship	−.06	−.07	−.05	−.04	.00	.00
Income	−.02	−.02	.05	.05	−.13**	−.14
Higher education	.05	.05	.26***	.24	−.34***	−.33
Female	−.02	−.02	−.00	−.00	.06	.05
Age (in years)	−.20***	−.20	−.06	−.05	.05	.05
No primary care provider	.03	.04	.01	.01	.02	.02
Diabetes class (past 12 months)	.05	.06	−.02	−.02	.11*	.13
R^2	.08**		.11***		.21***	
Step 2						
Disease context						
Diabetes Type (2 Vs. 1)	−.08	−.08	−.01	−.01	−.09	−.08
Baseline HbA1c	.12*	.04	−.07	−.07	−.04	−.04
Insulin	.07	.08	.07	.06	.02	.02
No. of diabetes complications	.14**	.15	−.02	−.02	.02	.02
No. of comorbidities	.16**	.15	.02	.02	.07	.06
Diagnosis years	.03	.04	.01	.01	.00	.00
Physical symptoms	.32***	.32	−.01	.00	.09	.09
R^2	.34***		.12**		.24***	
ΔR^2	.25***		.01		.03	

Note. Standardized β's reported. *$p < .05$; **$p < .01$; ***$p < .001$.

Mental Component Summary), except for a fairly week negative correlation with baseline HbA1c [$r(440) = -.12, p < .05$]. Bivariate correlations showed that Seriousness beliefs were more strongly related to 6-month clinical measures than to baseline measures. Seriousness beliefs were associated with worse HbA1c levels [6-month $r(370) = .12, p < .05$] and poorer scores on the Physical [baseline $r(452) = -.39, p < .001$; 6-month $r(452) = -.45, p < .001$] and Mental [baseline $r(452) = -.001$; 6-month $r(452) = -.36, p < .001$] Component Summary scales of the SF-12. Fatalistic beliefs were not associated with HbA1c, but were negatively correlated with the Mental [baseline & 6-month $r(452) = -.18, p < .001$] and concurrent Physical [$r(452) = -.17, p < .001$] Component Summary scales.

After controlling for patients' baseline HbA1c values, as well as sociocultural and other health factors, beliefs about the seriousness of diabetes showed an independent and significant association with HbA1c values at 6 months. In addition, there

was a Seriousness X Fatalism interaction (Refer to Table IV). To explore this interaction, simple slope analyses were conducted by using values of seriousness beliefs corresponding to the mean and one standard deviation above and below the mean (Cohen and Cohen, 1983; Aiken and West, 1991). The computer procedure outlined by Darlington (1990) was used to calculate simple slopes for HbA1c and fatalism at standard deviation divisions for Seriousness beliefs. A significant simple regression coefficient was found between fatalism and HbA1c at the mean ($B = .402, p = .002$) and one standard deviation below the mean ($B = .201, p = .008$), but not at one standard deviation above the mean ($p > .52$). Specifically, for patients who had lower to average ratings of the seriousness of their diabetes, higher levels of fatalism was associated with higher HbA1c levels. Individuals with stronger beliefs about the seriousness of their diabetes had poorer diabetes control, regardless of fatalism levels. However, even when beliefs about the seriousness

Table IV. Summary of Hierarchical Linear Regression Analysis on Sociocultural, Health, and Illness Belief Predictors of Clinical Indices of Diabetes Control and Health

Variable	Clinical measures		
	HbA1c β's	Physical health β's	Mental health β's
Step 1: Context			
Ethnicity	.01	.08	-07
System of care	.08	.05	−.08
Income	.00	.12*	.05
Education level	.01	.13**	−.06
Relationship	−.03	.06	−.09
Female	.08	−.13*	.02
Age	.01	−.10*	.18**
No provider	.05	.00	.07
Diabetes class (past 12 months)	.01	−.09*	−.06
R^2	.07*	.16***	.10***
Step 2: Diabetes severity			
Type 1	.01	−.12*	−.02
Insulin use	.05	−.05	.01
Diabetes complications	−.07	−.10*	.09
Comorbidities	.03	−.14**	−.09
Years since diagnosis	.12*	.02	−.01
Symptoms	−.00	−.29***	−.30***
Baseline HbA1c	.64***	.03	.02
R^2	.53***	.46***	.17***
ΔR^2	.46***	.31***	.27***
Step 3: Personal models			
Seriousness	.66*	−.26	−.22
Treatment	.04	.14	−.17
Fatalism	.06	.17	−.05
Seriousness × Fatalism	−.40*	.01	−.27
Seriousness × Treatment	−.51	−.05	.24
Fatalism × Treatment	.26	−.15	.16
R^2	.55***	.51***	.31***
ΔR^2	.02	.05***	.04*

Note. Standardized β's reported. $^*p < .05$; $^{**}p < .01$; $^{***}p < .001$.

of diabetes were relatively low, high levels of fatalism were related to poorer diabetes control. In sum, only those patients with both low/moderate beliefs about seriousness along with less fatalism for their diabetes had good diabetes control. Elevations in beliefs about seriousness were associated with poorer diabetes control. HbA1c was primarily explained by disease variables (46%) with personal models of diabetes only accounting for .02% of the variance in HbA1c.

Personal models of diabetes accounted for a greater additional percentage of variance in Physical and Mental Component Summary measures health (5% and 4%, respectively) than for HbA1c. However, after controlling for sociocultural and disease severity factors, no dimensions of personal models were individually associated with general physical and mental functioning severity scores.

DISCUSSION

In this large socio-demographically diverse sample of patients with diabetes, we corroborated prior findings regarding the existence of two major personal model dimensions for diabetes: Seriousness and Treatment Effectiveness (Hampson *et al.*, 1990; Hampson *et al.*, 1995). In addition, we found that patients with diabetes have a view of their diabetes that is largely consistent with that of most Western medical providers. A majority of patients reported their diabetes to be at least moderately serious and strongly believe that treatment is very important in preventing complications. Over 70% of the sample reported treatment to be very to extremely important in managing their diabetes which suggests that the majority of patients trust and endorse medical advice. This belief did not differ consistently across

groups defined by ethnicity, gender, and other socio-demographic characteristics. This is an encouraging finding as research shows that strong beliefs about the treatment effectiveness for diabetes are associated with better self-management (Glasgow *et al.*, 1997; Hampson *et al.*, 1990; Hampson *et al.*, 1995; Skinner and Hampson, 2001). Overall, the sample was not very fatalistic, with only about 17% endorsing some degree of fatalism.

We predicted that past complications from diabetes and disease history would be related to representations about the seriousness of diabetes. Bivariate analyses showed that disease variables were associated with seriousness models, and multivariate analyses showed that this was true even after controlling for sociocultural factors. In fact, disease and symptom indices accounted for a majority of the predictive power of the model. Seriousness beliefs were positively associated with age, yet other patient characteristics, such as gender and SES, were not correlated with perceived disease seriousness. Disease-related factors far outweighed other contextual factors in explaining variance in seriousness beliefs for diabetes. Recent physical symptoms proved to be the strongest predictor of personal models regarding the seriousness of diabetes, supporting research and theory suggesting that symptoms are considered an important indicator of illness degree by patients (Leventhal *et al.*, 1980; Lange and Piette, 2005).

It appears that patients utilize such factors as symptoms, complications and glucose control in rating the seriousness of their diabetes. This finding is encouraging as it indicates that patients with diabetes assess the severity of diabetes based upon metabolic control and other disease factors. However, this finding also may be met with caution as patients may not take their condition seriously until repercussions of the disease occur. Perhaps designing interventions to help patients realize the seriousness of diabetes before direct experience with poor glucose control and complications would prove beneficial. It is unclear, however as to how assessments of diabetes seriousness translates into behavior, and research on personal models of diabetes suggest that treatment effectiveness beliefs are better predictors of self-care behaviors (Glasgow *et al.*, 1997; Skinner *et al.*, 2000). Further research should investigate the relationship of self-care and severity beliefs as well as the potentially complex interplay between personal models, disease, and self-care behavior.

Not only were seriousness representations found to be highly steeped in disease progression variables, they were further associated with clinical measures of glycemic control. Patients appear to be quite accurate in their assessment of diabetes seriousness when indeed their condition has deteriorated and/or impacted their lives directly. However, a Seriousness X Fatalism interaction suggests some misjudgments on the part of patients who are fatalistic. Specifically, for those patients who rated seriousness from low to moderate, high levels of fatalism were associated with higher HbA1c levels. In this case, poor glucose control does not result in patients taking their condition more seriously. Perhaps a fatalistic view of diabetes precludes or somehow hinders patients from determining that diabetes is a serious condition.

Causality or directionality of the relationship cannot be determined in the current study, because beliefs and follow-up HbA1c values were measured concurrently. However, given that HbA1c represents glucose control for the preceding 3 months, it is possible that patients used this information, or general knowledge of glycemic control through self-testing, in the formulation of their illness representations. Whereas adequate HbA1c control does not necessitate increasing beliefs in disease seriousness or controllability, poorer diabetes control may lead to elevated beliefs in the severity of diabetes. Some patients may blame their poor diabetes control on fate whereas others appear to accurately interpret their illness as more severe. Beliefs that diabetes is a nonserious illness in combination with greater beliefs in fate may lead patients to take a passive role in their diabetes management. Additional research is needed to investigate the potential long-term effects of fatalistic beliefs on continued diabetes control and longitudinal data will be helpful in teasing out interactions and causal pathways.

Although proposed in theoretical models, a paucity of research studies has actually investigated the relationship of contextual variables with personal models for treatment effectiveness. Regression models in the current study only accounted for 11.7% of the variance in Treatment Effectiveness beliefs, with sociocultural context contributing to the majority (10.8%) of explanation and disease context only contributing minimally. However, the contribution of sociocultural context is modest at best and future research is needed to identify factors that better contribute to these important cognitive dimensions of diabetes.

Patients do not appear to incorporate their own health history in determining the importance of treatment in managing diabetes. This belief in treatment is somewhat independent of their own disease state and is instead related most to other contextual factors such as educational attainment. Bivariate analyses revealed that significant improvements in beliefs about the importance of treatment were found with increasing educational attainment. Specifically, patients with at least some college education reported greater confidence in treatment effectiveness than those with no college education. Higher educational attainment is associated with greater access to and use of self-care resources (e.g., self-care books, online health information; Hibbard *et al.*, 1999) which may lead to greater knowledge and endorsement of conventional medicine.

Sociocultural and healthcare context variables accounted for a majority of the variance in fatalism, with disease variables adding only 2.6% of the explanatory power in the regression model. Investigation of individual coefficients showed that fatalism was associated with education level, ethnicity, income level, and diabetes-specific education. Taking at least one diabetes class in the past year, greater educational attainment, and a household annual income over $20 K were associated with a lesser degree of fatalism.

The literature is inconsistent regarding the degree of fatalistic beliefs in the Latino population compared to other ethnic and racial groups, and research on various ethnic groups within the United States has only indicated modest differences in health beliefs (e.g., Weitzel *et al.*, 1994). Moreover, research on Latino beliefs for diabetes across various geographical regions suggests concordance with biomedical models of diabetes (Weller *et al.*, 1999). After controlling for socioeconomic confounds, our study showed that Hispanic/Latino patients did not differ from other groups on seriousness representations, but that they did report more fatalism than patients from other ethnic categories. However, this relationship was moderate and may be secondary to education level as indicated by the strength of coefficients and partial correlations. It appears that higher educational attainment brings beliefs about diabetes more in line with current medical views and this finding is consistent with research showing that greater education in the Latino population is associated with more knowledge about diabetes (Weller *et al.*, 1999). Although, it should be noted that we did not measure culture directly, nor did we account for varying levels of acculturation within the Latino sample. These limitations may explain the comparatively weak relationship between ethnic group and fatalistic models. Further research should measure culture more directly and account for acculturation to gain a better understanding of the relationship to illness beliefs (Baumann, 2003). The relationships between ethnicity and education level with fatalism beliefs should promote sensitivity to alternative viewpoints about variation in health beliefs across ethnic groups. Greater understanding of these relationships will be important for developing appropriate plans for care and culturally competent interventions (e.g., Brown *et al.*, 2002.)

Overall, representations within the general category of diabetes controllability (i.e., treatment effectiveness, fatalism) were most consistently related to socio-demographic measures of education. Fatalism was related to a broader mix of sociocultural variables, including ethnicity and income level. The mechanisms explaining the consistent influence of education on personal models for diabetes controllability are unclear. However, obtaining higher levels of education appears to be an important factor in the development and perpetuation of important beliefs that diabetes can be controlled through one's actions and self-care. More research is needed to investigate this relationship and to discern causal mechanisms. Perhaps the thinking styles taught and practiced in higher education leads to greater ability to evaluate the evidence and additionally greater confidence in scientifically evaluated treatment methods.

As mentioned in earlier, further prospective and longitudinal designs are needed to determine causality and directionality of relationships given the limitations of a cross sectional design. And, although the sample was socio-demographically diverse, Latino/Hispanic patients and patients outside of the VA were less likely to complete the study, which compromises interpretation of the results to some degree. For example, the true extent of the impact of culture on illness models may have been under- or over-estimated in the current study given the unequal representation of individuals who completed the follow-up. Finally, future research should investigate potential mechanisms, such as self-care behaviors, that explain the relationship between personal models of diabetes and glucose control.

In summary, patients in the current study had a sophisticated and medically consistent cognitive representation of diabetes. Our study shows factors associated with various belief dimensions for diabetes.

Although seriousness representations were largely determined by patients logically incorporating such factors as symptoms and diabetes complications, these disease-specific factors were not related to treatment effectiveness and fatalism. Rather, certain subgroups were identified as demonstrating lower confidence in treatment effectiveness and higher levels of fatalism. These faulty beliefs may be considered dangerous as they may translate into poor disease management. Targeting these "at risk" populations to modify inaccurate personal models of diabetes may prove effective in improving diabetes self care behaviors and health outcomes.

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