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ORIGINAL ARTICLE

Exploring the role of the patient–physician relationship on insulin adherence and clinical outcomes in type 2 diabetes: Insights from the MOSAIc study†

Highlights
• Patient perceptions of the quality of their interactions with their physicians have a significant association with total diabetes-related distress. Diabetes-related distress and patient-physician interactions have a significant independent association with insulin adherence and HbA1c level.
• This study delineates specific aspects of the patient-physician interaction that are linked to diabetes-related distress, insulin adherence behavior, and glycemic control.

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Abstract

Background: The 2-year prospective MOSAIc (Multinational Observational Study assessing Insulin use: understanding the challenges associated with progression of therapy) study is investigating whether patient-, physician-, and health system-related factors affect outcomes in patients with type 2 diabetes (T2D). This baseline subanalysis investigated how aspects of the patient–physician relationship are associated with diabetes-related distress, insulin adherence, and glycemic control.

Methods: Patients with T2D taking insulin for ≥3 months were recruited at primary care and specialty practice sites in 18 countries. Physicians provided usual care. Clinical history and most recent HbA1c values were collected; patients were surveyed regarding their perception of physician interactions, diabetes-related distress level, and insulin adherence.

Results: The analysis population comprised 4341 patients. Four (of six) domains showed a significant relationship with total diabetes-related distress ($P < 0.01$). Poor insulin adherence was associated with greater diabetes-related distress (adjusted odds ratio [aOR] 1.14; 95% confidence interval [CI] 1.06–1.22), higher Discrimination (aOR 1.13; 95% CI 1.02–1.27) and Hurried Communication (aOR 1.35; 95% CI 1.20–1.53) scores, and a lower Explained Results score (aOR 0.86; 95% CI 0.77–0.97). Poor insulin adherence was associated with a 0.43% increase in HbA1c, whereas a 1-unit increase in total diabetes-related distress and Hurried Communication scores was associated with a 0.171% and 0.145% increase in HbA1c, respectively.

Conclusions: Patients distressed about living with T2D, and dissatisfied with aspects of their interactions with physicians, exhibited poor insulin adherence. Perceived physician inattention and lack of engagement (and diabetes-related distress) directly affect insulin adherence and glycemic control.

Keywords: medication adherence, patient–physician relationships, type 2 diabetes.

Introduction

A growing body of literature supports the positive effect of clear patient–provider communication in diabetes on patient outcomes. Evidence from a series of cross-sectional studies indicates that a patient's relationship with his or her healthcare provider is closely related to patient self-management behavior.[1–3] A multinational survey of 2000 patients with diabetes found that patients' ratings of providers' communication effectiveness showed a positive relationship with self-management behavior.[1] Another large survey of adults with diabetes that examined general and diabetes-specific communication found that patients' adherence to various self-management activities was positively associated with healthcare provider communication.[2] The cross-sectional Diabetes Attitudes, Wishes and Needs (DAWN) study assessed the relationship of self-reported well being, self-management, and diabetes control with factors related to patients' health care in patients with type 1 (T1D) and type 2 diabetes (T2D).[3] According to that study, better patient–provider collaboration was associated with more favorable ratings on all patient-reported outcome measures, including diabetes-related distress, general well being, lifestyle and medical regimen adherence, perceived diabetes control, and hyperglycemic symptoms.[3] The second DAWN study (DAWN2) highlighted the need for an improvement in patient–provider interactions; for example, most providers (63%) agreed that there is a major need for better availability of resources for the provision of psychosocial support and that providers and patients differ considerably with regard to their perceptions about the support being given.[4] The global IntroDia™ study investigated the effect of early patient–physician conversations on patient self-care and self-reported outcomes and found that better physician communication at the time of diagnosis, as recalled by patients, was linked to less diabetes distress, greater well being, and greater adherence to self-care behaviors.[5]

The importance of patient–provider communication and self-care behavior is reflected in the most recent American Diabetes Association (ADA)/European Association for the Study of Diabetes (EASD) position statement, which advocates a patient-centered approach that takes into account the patient's attitude and expected treatment efforts.[6] In order to be able to guide improvements and healthcare provider education to improve patient–provider communication, it would be valuable to understand which elements of the patient–provider interaction affect self-management behavior and, ultimately, clinical outcomes.

One area of critical importance is medication adherence, and here there is specific evidence that patient–provider communication plays a key role.[5,7–10] In particular, adherence to prescribed insulin regimens is known to be a significant issue. For example, in a telephone survey of 1530 insulin-treated patients, one-third of patients reported missing shots at least one day in the past month, with an average of 3.3 days missed.[11] These results are consistent with prior findings that patients with T2D have insulin adherence rates in the range 59%–77%.[12] Although we may presume that patient–physician communication plays an important role in adherence to insulin, we are not aware of any published research in this area.

The Multinational Observational Study assessing Insulin use: understanding the challenges associated with progression of therapy (MOSAIc) is a 2-year prospective multinational observational study to determine if patient-, physician-, and health system-related factors affect treatment progression in patients with T2D and to quantify relationships between these factors and long-term clinical outcomes. The primary aim of the present baseline analysis was to investigate how key aspects of the patient–physician relationship may be related to patient levels of diabetes-related distress, insulin adherence, and HbA1c levels. Specifically, the aim was to test the hypothesis that patient–physician interactions and diabetes-related distress may have independent and combined effects on both insulin adherence and glycemic control.

Methods

Study design

A detailed description of the MOSAIc methods, including design, data collection, data management, and statistical analysis, has been published elsewhere.[13] This multinational prospective observational cohort study was performed in patients with T2D using insulin therapy for ≥3 months to collect real-world data, including demographic, clinical, and psychosocial data, about patients' care and health outcomes at regular intervals over a 24-month follow-up period. Physicians provide usual care to their patients, reflecting characteristics and patterns of patients with T2D and their treatments in real-world settings.

The present analysis investigates cross-sectional associations between key psychosocial dimensions assessed at baseline (patients' perspective regarding their interactions with their physician and diabetes-related distress) and insulin adherence, as well as the potential effect of these factors on baseline HbA1c. The conceptual model tested builds on that investigated by Heisler et al.[1] and is shown in Fig. 1.

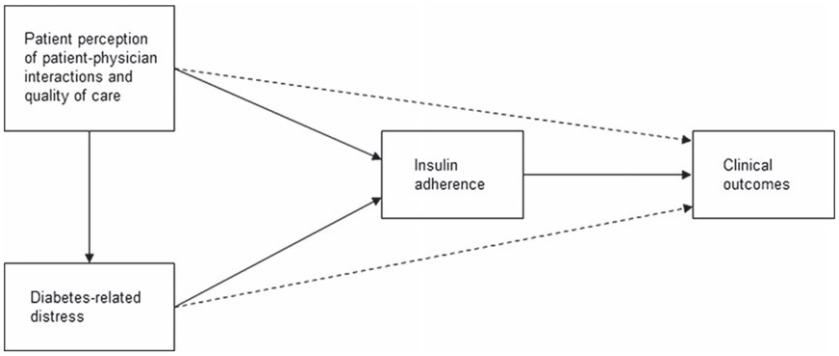

Figure 1 Conceptual model tested: hypothesis as to how patient perception of care affects distress status, insulin adherence, and the relationship with clinical outcomes.

Patient population

The MOSAIc study was conducted at primary care and specialty practice sites in 18 countries (Argentina, Brazil, Canada, China, Germany, India, Israel, Italy, Japan, Mexico, Russia, Saudi Arabia, South Korea, Spain, Turkey, United Arab Emirates, UK, and US, including Puerto Rico). To be eligible for inclusion, patients had to be: aged ≥18 years; diagnosed with T2D; taking any commercially available insulin (except intensive basal-bolus insulin therapy, such as basal + three prandial injections) from any manufacturer for ≥3 months alone or in combination with approved non-insulin antidiabetic medications; not simultaneously participating in any study with an investigational drug or procedure; proficient in the country's primary language; and able to provide written informed consent prior to study enrolment. Patients were recruited from both primary care practices and diabetes specialty clinics at sites in rural and urban locations and academic and non-academic settings. The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki and is consistent with the applicable laws and regulations of the countries in which the study was conducted. All patients completed informed consent forms approved by their country-specific institutional review boards. This study is registered with ClinicalTrials.gov (ID: NCT01400971).

Data collection

Retrospective data collection occurred at the baseline visit (for the period beginning 6 months prior to baseline), with prospective collection occurring during four subsequent visit windows (within ±3 months) at 6, 12, 18, and 24 months after baseline. Baseline data relating to T2D clinical history, including diagnosis, treatment, and complications, and medication history were collected from medical records. Most recently recorded laboratory values were documented but limited to the period 6 months prior to the baseline visit.

Information on patients' diabetes- and insulin-related attitudes and behaviors was collected using patient questionnaires administered at baseline. These questionnaires included the Interpersonal Processes of Care (IPC) survey[14] and the Diabetes Distress Scale (DDS)[15] to assess patients' perceptions of their interactions with their physicians and their levels of diabetes-related distress, as well as additional questions to evaluate the current insulin regimen and insulin adherence behavior.

The IPC survey was used to assess patients' perceptions of specific domains of the relationship with their physicians over the past 12 months.[14] The IPC survey is a validated questionnaire developed to evaluate the patient–physician interpersonal process of care that is designed to be suitable for diverse population groups and languages.[14] However, one of the IPC dimensions, the four-item Disrespectful Office Staff domain, was not included in the final questionnaire battery; these results were not considered relevant or likely to provide accurate information given that the staff were entering the information into the electronic case report forms. From the 25 IPC items, six domains were assessed[16]: (i) Hurried Communication (doctors spoke too fast, used complex words, ignored what I told them, appeared distracted, seemed bothered if I asked several questions); (ii) Elicited Concerns (doctors heard my concerns and took them seriously); (iii) Explained Results (doctors explained results of tests or examinations and explained the possible side effects, as well as consequences of not taking, prescribed medicines); (iv) Patient-centered Decision Making (doctors asked about preferences for helping to decide treatment and whether I would be able to follow the treatment); (v) Compassionate/Respectful (doctors expressed concern about my feelings, were compassionate, supportive and respected me); and (vi) Discrimination (doctors made assumptions about

my education and income status and I felt discrimination or inattentiveness because of my race or ethnicity). Each of the 25 items was rated by patients on a five-point scale, from 1 (never) to 5 (always). For the positive IPC domains (Elicited Concerns, Explained Results, Patient-centered Decision Making, Compassionate/Respectful), higher scores indicated more satisfying interactions. For the negative IPC domains (Hurried Communication and Discrimination), lower scores indicated more satisfying interactions.

The DDS is a 17-item scale for the assessment of diabetes-related emotional distress.[15] The DDS is a validated instrument with high reliability that has been shown to be applicable to different ethnic groups.[15] Patients were asked to rate the extent to which potential problems they may experience have bothered them during the past month. Responses are rated on a six-point scale, from 1 (not a problem) to 6 (a very serious problem). Higher scores represent greater diabetes-related distress.

Two questions were asked about the current insulin regimen and insulin adherence as follows:

1. How many times do you take your insulin a day? (Four response options, from once a day to more than three times a day.)
2. How often did you miss your insulin shot during the last seven days? (Response options: "I did not miss any shots", "I missed [some/about half/most/all] of my shots".)

Statistical analysis

Descriptive summary analyses (mean ± SD, frequency) are reported for baseline characteristics, clinical variables, and laboratory values, and missing values were imputed by the multivariate imputation by chained equations method. Countries were divided into three income groupings according to The World Bank definitions using gross national income per capita (lower middle income: US$1046–4125; upper middle income: US$4126–12 735; and high income: US$12 736 or more; 2016 Fiscal Year: http://siteresources.worldbank.org/DATASTATISTICS/Resources/OGHIST.xls, accessed 4 July 2016).

Insulin adherence was reported as complete adherence (patients who reported they missed no shots) or poor adherence (patients who reported missing "some", "about half", "most" or "all" of their insulin shots) during the past 7 days. Because of the skewed distribution of responses, insulin adherence was analyzed as a binomial variable with responses split between complete and poor adherence. Unadjusted and adjusted regression estimates were calculated for the total distress results, insulin adherence (measured as frequency of missed shots), and HbA1c level. Linear regression was used for DDS and HbA1c, whereas logistic regression was used for adherence.

Structural equation modeling was used to investigate the relationships between the IPC domains, total distress, insulin adherence, and HbA1c level. Specifically, the maximum likelihood estimator with robust standard errors using a numerical integration algorithm was used in path analyses for this purpose. Structural equation modeling has been advocated over regression methods for testing mediated effects because it allows measurement error to be controlled for.[17] Analysis-wide statistical significance was conducted at the 0.05 level. Regression analyses were performed using SAS 9.2 (SAS Institute, Cary, NC, USA) and structural equation modeling was performed using Mplus 7.3 (Mplus, Los Angeles, CA, USA).

Results

Patient characteristics

In all, 4341 patients met MOSAIc eligibility criteria and were included in the analysis population. Mean patient age was 61.8 years, 50% were female, mean T2D duration was 12.7 years, and mean baseline HbA1c was 8.1%. Of note, 76% of the sample reported that they missed no insulin injections during the previous week. An overview of the baseline characteristics and pooled results for the IPC and DDS questionnaires are given in Table 1. Further details about baseline characteristics for the MOSAIc sample have been published elsewhere.[18]

Effect of patient–physician communication on diabetes-related distress

Higher scores in the two negative IPC domains (Hurried Communication and Discrimination) were independently linked with greater diabetes-related distress (Table 2). In addition, higher scores in two of the positive IPC domains (Explained Results and Patient-centered Decision Making) were independently associated with lower levels of diabetes-related distress. Hurried Communication showed a markedly stronger association with diabetes-related distress than any other IPC domain (adjusted regression estimate 0.40; $P < 0.001$).

Effect of patient–physician communication and diabetes-related distress on insulin adherence

Greater likelihood of missed insulin injections was independently associated with higher scores on the two negative IPC domains, namely Hurried Communication (adjusted odds ratio [aOR] 1.35; 95% confidence interval [CI] 1.20–1.53) and Discrimination (aOR 1.13; 95% CI

Table 1 Patient characteristics and Interpersonal Processes of Care (IPC) survey,[14] diabetes-related distress, and insulin adherence results for patients enrolled in the Multinational Observational Study assessing Insulin use: understanding the challenges associated with progression of therapy (MOSAIc) at baseline

Age (years)	61.77 ± 11.02
No. females	2176 (50.13)
Duration of diabetes (years)	12.65 ± 7.98
HbA1c (%)	8.13 ± 1.75
Country income level[a]	
Low middle	918 (21.15)
Upper middle	1177 (27.11)
High	2246 (51.74)
Education level	
Primary	1291 (29.74)
High school	1216 (28.01)
College	1499 (34.53)
Insurance status	
Uninsured	848 (19.53)
Private	917 (21.12)
Public	2229 (51.35)
IPC domain scores	
Hurried Communication	1.58 ± 0.70
Elicited Concerns	3.92 ± 1.04
Explained Results	3.92 ± 1.01
Patient-centered Decision Making	3.36 ± 1.21
Compassionate/Respectful	4.10 ± 0.88
Discrimination	1.51 ± 0.73
Diabetes Distress Scale[15] score	
Total distress	2.27 ± 1.13
Insulin treatment regimen	
Mean no. shots per day	1.63 ± 0.68
No. shots per day	
One	1977 (45.54)
Two	1921 (44.25)
Three	244 (5.62)
More than three	77 (1.77)
Insulin adherence (missed insulin shots in last 7 days)	
I did not miss any shots	3290 (75.79)
I missed some/about half/most/all shots	927 (21.35)

Data are given as the mean ± SD or as n (%).
[a]Country income was grouped according to The World Bank definitions using gross national income per capita as follows: lower middle income, US$1046–4125; upper middle income, US$4126–12 735; and high income, US$12 736 or more (2016 Fiscal Year: http://siteresources.worldbank.org/DATASTATISTICS/Resources/OGHIST.xls, accessed 4 July 2016).

1.02–1.27), with lower scores on one of the positive IPC domains (less time spent having medical tests and results explained; aOR 0.86; 95% CI 0.77–0.97) and with greater diabetes-related distress (aOR 1.14; 95% CI 1.06–1.22; Table 3).

Effect of patient–physician communication, diabetes-related distress, and insulin adherence on HbA1c

Higher HbA1c level was independently linked with diabetes-related distress (adjusted regression estimate 0.12; $P < 0.01$), the Hurried Communication domain of the IPC scale (adjusted regression estimate 0.16; $P < 0.01$), and poor insulin adherence (adjusted regression estimate 0.31; $P < 0.001$; Table 4).

Modeling associations between HbA1c, insulin adherence, and psychosocial factors

Structural equation modeling was performed to estimate the relationships between aspects of patient–physician communication, diabetes-related distress, insulin adherence, and HbA1c level. Path analysis (Fig. 2) shows the parameter coefficients for the interactions between these factors. Paths from four of the IPC domains (Patient-centered Decision Making, Discrimination, Explained Results, and Hurried Communication) to total diabetes-related distress were significant and in the predicted direction, with a particularly high proportion of diabetes-related distress explained by the Hurried Communication domain (parameter coefficient 0.414).

Variance in insulin adherence behavior was explained by three of the same IPC domains (Discrimination, Explained Results, and Hurried Communication) and by diabetes-related distress. A single-unit increase in the total distress score was associated with an 18% increase in the likelihood of poor insulin adherence (parameter coefficient 0.168; OR 1.18). Single-unit increases in the Hurried Communication and Discrimination domain scores were associated with 29% and 19% increased odds of poor insulin adherence (parameter coefficients 0.254 and 0.176; ORs 1.29 and 1.19, respectively), whereas the same increase in the Explained Results domain was associated with a 15% reduction in the odds of poor insulin adherence (parameter coefficient −0.158; OR 1.15).

Insulin adherence behavior explained a substantial proportion of HbA1c level, with poor insulin adherence linked with a 0.43% increase in HbA1c. Diabetes-related distress and Hurried Communication were also linked directly with HbA1c level, with a single-unit increase in each associated with a 0.171% and 0.145% increase in HbA1c, respectively.

Discussion

This baseline analysis of cross-sectional data obtained as part of the global MOSAIc study demonstrated, through regression analyses and structural equation modeling, a significant relationship between aspects of the patient–physician relationship, insulin adherence, and HbA1c level (Fig. 2). We observed more problematic insulin adherence when patients were distressed about living with T2D and when there were aspects of their interactions with their physicians with which they were dissatisfied.

Table 2 Unadjusted and adjusted regression estimates for the effects of patient characteristics and Interpersonal Processes of Care (IPC)[14] scores on diabetes-related distress

	Diabetes-related distress	
	Unadjusted regression estimate (95% CI)	**Adjusted regression estimate (95% CI)**
Age	−0.02*** (−0.02, −0.01)	−0.02*** (−0.02, −0.01)
Female gender	0.14*** (0.07, 0.20)	0.11*** (0.04, 0.17)
Diabetes duration	−0.01*** (−0.01, −0.00)	0 (−0.00, 0.01)
Country income[a]		
Upper middle	0.18*** (0.08, 0.28)	0.19** (0.09, 0.30)
High	0 (−0.09, 0.08)	0.06 (−0.03, 0.15)
Education level		
High school	−0.08 (−0.17, 0.01)	−0.02 (−0.11, 0.06)
College	0.05 (−0.03, 0.14)	0.06 (−0.03, 0.14)
Insurance status		
Public	0.13** (0.04, 0.22)	0.09 (−0.00, 0.18)
Private	−0.01 (−0.11, 0.10)	0.04 (−0.06, 0.14)
IPC domain scores		
Hurried Communication	0.42*** (0.37, 0.47)	0.40*** (0.35, 0.46)
Elicited Concerns	0.01 (−0.03, 0.05)	0.02 (−0.02, 0.06)
Explained Results	−0.07** (−0.12, −0.03)	−0.07** (−0.12, −0.02)
Patient-centered Decision Making	−0.05** (−0.09, −0.02)	−0.07*** (−0.10, −0.03)
Compassionate/Respectful	−0.04 (−0.09, 0.01)	−0.03 (−0.08, 0.02)
Discrimination	0.17*** (0.12, 0.21)	0.16*** (0.11, 0.21)

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

The adjusted regression model includes all parameters (age, gender, diabetes duration, country income, education level, insurance status, interpersonal processes of care domain results).

Lower middle country income, primary education level, and uninsured insurance status served as reference groups for the regression analysis and are not shown in the table.

[a]Country income was grouped according to The World Bank definitions using gross national income per capita as follows: lower middle income, US$1046–4125; upper middle income, US$4126–12 735; and high income, US$12 736 or more (2016 Fiscal Year: http://siteresources.worldbank.org/DATASTATISTICS/Resources/OGHIST.xls, accessed 4 July 2016).

CI, confidence interval.

Problematic insulin adherence was associated with a 0.43% increase in HbA1c level, confirming the findings of other studies that have reported a significant relationship between medication adherence and HbA1c.[19] In terms of the factors that drive insulin adherence, various domains of the patient–physician relationship, as well as total distress, were shown to influence the likelihood of missing insulin shots. In particular, a patient's perception of Hurried Communication showed a substantial effect on insulin adherence, with a 29% increased likelihood of a patient missing at least some insulin shots associated with a single-unit increase in the score for Hurried Communication by their physician. The Hurried Communication domain provides a measure of not only how quickly the physician spoke, but also the patient's perception of whether the physician used complex words, appeared distracted, seemed bothered when the patient asked questions, or ignored the patient's input. This could also be described as a measure of the physician's perceived lack of engagement or inattentiveness during consultations. The Explained Results domain assessed whether the physician explained the results of examinations and tests, and importantly, whether he or she informed the patient of the possible side effects of prescribed medicines and the consequences of not adhering to the prescribed treatment regimen.

The results of the present study build on prior research and demonstrate the importance of healthcare professionals' communication skills and style on patients' emotional response to their condition, insulin adherence behavior, and HbA1c level. Mayberry and Osborn[19] tested an information–motivation–behavioral skills (IMB) model, the elements of which (i.e. adherence information, adherence motivation, and adherence behavior skills) explained 41% of the variability in medication adherence behavior. In the present study, we investigated the effect of patient–physician communication on insulin adherence, rather than overall medication adherence. We also looked at specific aspects of the patient–physician interaction that allowed us to reveal the particularly important effect of the Hurried Communication, Explained Results, and Discrimination domains. The effects of these particular aspects of the patient–physician

Table 3 Unadjusted and adjusted regression estimates for the effects of patient characteristics, Interpersonal Processes of Care (IPC)[14] scores, and diabetes-related distress on adherence, measured as missed shots

	Insulin adherence	
	Unadjusted OR (95% CI)	**Adjusted OR (95% CI)**
Age	0.96*** (0.95, 0.97)	0.97*** (0.96, 0.98)
Female gender	0.89 (0.77, 1.03)	0.9 (0.77, 1.06)
Diabetes duration	0.97*** (0.96, 0.98)	0.99* (0.98, 1.00)
Country income[a]		
Upper middle	0.83 (0.68, 1.01)	0.94 (0.74, 1.20)
High	0.60*** (0.50, 0.72)	0.77* (0.62, 0.96)
Education level		
High school	1.22* (1.00, 1.48)	1.12 (0.90, 1.38)
College	1.42*** (1.19, 1.71)	1.18 (0.97, 1.45)
Insurance status		
Public	0.84 (0.70, 1.02)	0.95 (0.76, 1.19)
Private	1.29* (1.04, 1.60)	1.42** (1.12, 1.79)
IPC domain scores		
Hurried Communication	1.36*** (1.21, 1.52)	1.35*** (1.20, 1.53)
Elicited Concerns	0.95 (0.87, 1.04)	0.93 (0.85, 1.02)
Explained Results	0.85** (0.76, 0.94)	0.86* (0.77, 0.97)
Patient-centered Decision Making	1.06 (0.97, 1.16)	1.03 (0.94, 1.13)
Compassionate/Respectful	1.01 (0.90, 1.13)	1.08 (0.96, 1.22)
Discrimination	1.24*** (1.12, 1.38)	1.13 (1.02, 1.27)
Diabetes-related distress	1.29*** (1.21, 1.37)	1.14*** (1.06, 1.22)
Insulin treatment regimen		
No. shots per day	1.25*** (1.12, 1.39)	1.23*** (1.10, 1.37)

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

The adjusted regression model includes all parameters (age, gender, diabetes duration, country income, education level, insurance status, interpersonal processes of care domain results).

Lower middle country income, primary education level, and uninsured insurance status served as reference groups for the regression analysis and are not shown in the table.

[a]Country income was grouped according to The World Bank definitions using gross national income per capita as follows: lower middle income, US$1046–4125; upper middle income, US$4126–12 735; and high income, US$12 736 or more (2016 Fiscal Year: http://siteresources.worldbank.org/DATASTATISTICS/Resources/OGHIST.xls, accessed 4 July 2016).

CI, confidence interval; OR, odds ratio.

interaction is supported by findings from several other studies,[1,3] including the Translating Research Into Action for Diabetes (TRIAD) study, which investigated barriers to insulin initiation in patients with T2D.[7] In the TRIAD study, compared with those who initiated, a significantly greater proportion of patients who failed to initiate prescribed insulin treatment reported that the risks and benefits of treatment were not well explained during their physician interactions, and a higher proportion of those who did not initiate treatment had inadequate health literacy and reported having problems learning about their medical condition.[7] The importance of patient–physician interactions is further underscored by the Forum for Injection Technique recommendations, which include guidelines for patient–physician communication aimed at achieving optimal injection technique.[20]

The many competing priorities during time-limited patient consultations, the complexity of the disease, and the factors that affect clinical outcomes support consideration of longer consultation times for the management of T2D by health policy makers. However, the findings of the present study suggest that identifying and implementing strategies to enhance physician engagement or attentiveness, and the quality of explanation regarding medical tests, the results, and the pros and cons of the prescribed treatment regimen, should be key focus areas in improving insulin adherence for patients with T2D.

The importance of a patient's experience interacting with their physician is further underscored by the direct association we reported between the patient–physician interaction and HbA1c level. The measure of physician inattentiveness showed a direct relationship with glycemic control that was separate from the effect on insulin adherence, lending support to the concept of patient empowerment. Perhaps having consultations with a physician who appears engaged, attentive, and willing to answer questions is more likely to engage and support patients' interests and confidence in their own

Table 4 Unadjusted and adjusted regression estimates of the effects of patient characteristics, Interpersonal Processes of Care (IPC)[14] scores, diabetes-related distress, and insulin adherence on HbA1c levels

	HbA1c	
	Unadjusted regression estimate (95% CI)	**Adjusted regression estimate (95% CI)**
Age	−0.02*** (−0.03, −0.02)	−0.02*** (−0.02, −0.01)
Female gender	0.11 (−0.01, 0.23)	0.08 (−0.04, 0.21)
Diabetes duration	−0.01 (−0.01, 0.00)	0 (−0.00, 0.01)
Country income[a]		
Upper middle	−0.34*** (−0.53, −0.15)	−0.47*** (−0.70, −0.24)
High	−0.51*** (−0.69, −0.34)	−0.45*** (−0.66, −0.25)
Education level		
High school	−0.12 (−0.28, 0.04)	−0.20* (−0.36, −0.03)
College	−0.19* (−0.36, −0.03)	−0.30** (−0.48, −0.12)
Insurance status		
Public	−0.28** (−0.46, −0.09)	−0.05 (−0.27, 0.16)
Private	−0.22 (−0.48, 0.04)	−0.04 (−0.30, 0.23)
IPC domain scores		
Hurried Communication	0.18*** (0.08, 0.28)	0.16** (0.05, 0.26)
Elicited Concerns	0.01 (−0.08, 0.11)	0.01 (−0.08, 0.10)
Explained Results	−0.04 (−0.15, 0.06)	−0.02 (−0.12, 0.09)
Patient-centered Decision Making	0.03 (−0.06, 0.11)	0.04 (−0.05, 0.12)
Compassionate/Respectful	−0.03 (−0.14, 0.07)	0 (−0.12, 0.11)
Discrimination	0 (−0.11, 0.11)	−0.11 (−0.22, 0.00)
Diabetes-related distress	0.17*** (0.11, 0.23)	0.12** (0.05, 0.19)
Insulin adherence		
Missed shots	0.46*** (0.32, 0.60)	0.31*** (0.17, 0.45)
Insulin treatment regimen		
No. shots per day	0.20*** (0.10, 0.30)	0.15** (0.05, 0.24)

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

The adjusted regression model includes all parameters (age, gender, diabetes duration, country income, education level, insurance status, interpersonal processes of care domain results).

Lower middle country income, primary education level, and uninsured insurance status served as reference groups for the regression analysis and are not shown in the table.

[a]Country income was grouped according to The World Bank definitions using gross national income per capita as follows: lower middle income, US$1046–4125; upper middle income, US$4126–12 735; and high income, US$12 736 or more (2016 Fiscal Year: http://siteresources.worldbank.org/DATASTATISTICS/Resources/OGHIST.xls, accessed 4 July 2016).

CI, confidence interval.

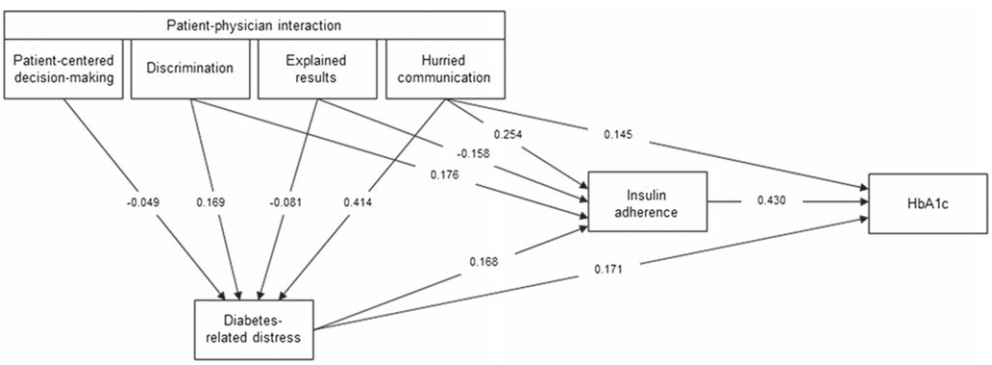

Figure 2 Path analysis showing associations between patient–physician interactions, diabetes-related distress, insulin adherence, and HbA1c level. The model is not adjusted for baseline covariates and shows only those factors with at least one significant interaction. Parameter coefficients in the path analysis are shown.

diabetes self-management, above and beyond careful attention to their insulin regimen. In support of this hypothesis, in one randomized controlled trial, patients with diabetes who were coached to ask more questions and be more proactive in raising concerns during medical consultations, thereby prompting better engagement

and attentiveness during the visit, had significantly better biomedical outcomes, including better glycemic control.[21]

One limitation of the present study is that insulin adherence was analyzed as a binomial outcome measure, with all responses indicating any degree of less-than-optimal adherence (≥1 missed shot/week) grouped together. This prevents us from distinguishing between patients with different degrees of poor adherence and the potential relationship that this may have on clinical outcomes. In addition, given the cross-sectional nature of these findings, causal inferences cannot be made. Furthermore, patient–physician differences in gender and language, which can play important roles in medication adherence,[22,23] were not assessed. Still, a significant relationship was identified between aspects of the patient–physician relationship, diabetes-related distress, insulin adherence, and HbA1c level. These data support the hypothesis that interactions between the patient and physician and diabetes-related distress may have a direct negative effect on insulin adherence and HbA1c level. Given the independent effect of patient–physician interactions on HbA1c, we would expect to find that there are other mechanisms involved beyond adherence to insulin regimens. Further investigations are being conducted over a 2-year period and will explore the involvement of other factors, such as diabetes knowledge and increase in self-care activities, as well as a careful examination of the temporal relationship between these factors.

The findings of the present study point to a clear relationship between diabetes-related distress and aspects of patient–physician interactions with insulin adherence in patients with T2D. Patients' perceptions of physician engagement and attentiveness, the quality of explanation about medical tests and their results, and discussion around the prescribed treatment regimen were directly associated with insulin adherence behavior. Diabetes-related distress and physician engagement and attentiveness were also shown to be independently linked to long-term glycemic control. Given the cross-sectional nature of the present study, the direction of the relationships between patient–physician communication, level of diabetes-related distress, and insulin adherence cannot be determined. However, the present findings are consistent with previous data suggesting that improving patient–physician interactions may help improve insulin adherence.[24] The findings suggest that efforts to enhance physician engagement and attentiveness, explanation of medical tests and their results, and discussion about the possible effect of the prescribed clinical management approach are warranted.

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