

# Perceptions and Attitudes Are Primary Contributors to Insulin Delivery System Satisfaction in People with Type 2 Diabetes

Risa P. Hayes, Ph.D.<sup>1</sup> and James T. Fitzgerald, Ph.D.<sup>2</sup>

## Abstract

**Background:** This study identifies factors that influence satisfaction with an insulin delivery system (IDS). Knowledge of such factors could help identify individuals who would benefit from innovative IDS.

**Methods:** Individuals with type 2 diabetes who use insulin, recruited from a general and chronic illness panel, participated in a web-based survey that included questions about demographics, self-reported diagnoses and hemoglobin A1c (HbA1c), current IDS used, insulin therapy attitudes, current IDS features, and satisfaction with IDS. Univariate analyses identified variables associated with IDS satisfaction ( $P < 0.05$ ); those variables were entered into stepwise linear regression analyses with IDS satisfaction as the dependent variable.

**Results:** Six hundred sixty-seven individuals with type 2 diabetes participated (mean age, 57 years; 52% female; 88% Caucasian; 73% vial/syringe users, 27% insulin pen users). IDS satisfaction was associated ( $P < 0.05$ ) with gender, health status, HbA1c, self-reported comorbidity, insulin therapy attitudes, IDS type, and evaluation of IDS features. Among individuals who reported their HbA1c ( $n = 438$ ), the best predictors of IDS satisfaction were perceived effectiveness and value of insulin therapy, evaluation of IDS activity interference, and commitment to insulin therapy ( $R^2 = 0.49$ ,  $P < 0.001$ ). Among all participants ( $n = 667$ ), a second regression analysis that employed a variable representing report of HbA1c found the best predictors of IDS satisfaction included those in the first analysis with the addition of gender, report of HbA1c, and evaluation of IDS ease of use. These variables provided additional variance ( $R^2 = 0.56$ ,  $P < 0.001$ ).

**Conclusions:** In people with type 2 diabetes, positive perceptions and attitudes about insulin therapy have greater influence than the type of IDS used on IDS satisfaction.

## Background

**D**URING 1999–2000, AN ESTIMATED 3 million individuals with type 2 diabetes in the United States were using insulin alone or in combination with oral antidiabetes medications.<sup>1</sup> Prior to the introduction of the insulin pen in the mid-1980s, the only insulin delivery option for patients with diabetes was the vial and syringe (v/s). Insulin pens have advantages over v/s that include portability, discreteness, and, in some cases, accuracy of dosing.<sup>2–5</sup> Crossover studies comparing insulin pens with v/s indicate that 70–90% of patients are more satisfied with and/or prefer the insulin pen over v/s.<sup>6–11</sup> Reasons for patient satisfaction/preference include less fear of injection<sup>6</sup> or pain of injection,<sup>7,9,10</sup> confidence in use and ease of use,<sup>6–10</sup> discreteness in public,<sup>6,8</sup> quicker administration,<sup>10,11</sup> and portability.<sup>11</sup> Results of these studies suggested that greater satisfaction with or preference for an

insulin pen would translate into better adherence and ultimately better outcomes.<sup>6–11</sup>

In many European countries and in Japan, insulin pens are the preferred mode of insulin delivery, with up to three-fourths of insulin prescriptions written for pen devices. In comparison, fewer than one in 20 insulin prescriptions in the United States are for insulin pens.<sup>4</sup> Physician recommendation of insulin pens is a strong predictor of whether patients with type 2 diabetes use an insulin pen.<sup>12</sup> Speculation is that physicians in the United States do not recommend or prescribe insulin pens because they lack formal training in pen use, believe pens are just novelty or convenience,<sup>2</sup> and/or do not regard pens as a mechanism for improved patient outcomes.<sup>12</sup> Physicians in the United States might be more likely to recommend insulin pens for patients with type 2 diabetes if they could identify patients who would benefit from pen use.

<sup>1</sup>Global Health Outcomes, Eli Lilly and Company, Indianapolis, Indiana.

<sup>2</sup>Department of Medical Education, University of Michigan, Ann Arbor, Michigan.

Diabetes treatment satisfaction has been linked to better treatment adherence,<sup>13</sup> and, in turn, better adherence has been linked to better outcomes.<sup>14-19</sup> Understanding what contributes to insulin delivery system (IDS) satisfaction is the initial step to identifying patients who would benefit from insulin pens. Studies have shown that individual characteristics can affect patient satisfaction regardless of the inherent properties of the item being evaluated. For example, patients' satisfaction with their physicians is associated with perceived health and psychosocial adaptation to diabetes.<sup>20</sup> Satisfaction with dietary management can be influenced by age, gender, depression, and employment status.<sup>21</sup> Correlates of diabetes treatment satisfaction<sup>22</sup> and, more specifically, insulin therapy satisfaction include hemoglobin A1c (HbA1c), age, and comorbidities.<sup>23,24</sup> We hypothesize that some patient characteristics contribute to IDS satisfaction independent of IDS. The identification of these patient characteristics could facilitate identifying patients who would most benefit from insulin pen use.

The objective of this study is to address the following two research questions:

1. For persons with type 2 diabetes using v/s only or an insulin pen, what characteristics are significantly associated with their IDS satisfaction?
2. Of the characteristics identified in question 1, which are the best predictors of IDS satisfaction?

**Subjects and Methods**

*Study design and participants*

This study was an internet-based survey of individuals with type 2 diabetes and using insulin conducted in early 2006. Participants were recruited from a large U.S. general and chronic illness panel. Panel members consented to participate in a study when they signed up and agreed to be part of the panel online and again when they responded to a confirmation e-mail.

Respondent eligibility criteria were (1) current diabetes therapy must include at least one daily injection of insulin, (2) must have used a v/s or an insulin pen for at least 3 months but not longer than 10 years, (3) must never have participated in an inhaled insulin trial, and (4) must not be currently participating in a diabetes clinical trial.

E-mail invitations were sent to 11,883 adults in the general and chronic illness panel; 4,150 adults (35%) responded to the e-mail invitation, and 681 (16%) were eligible for the study and completed the survey. However, 14 respondents indicated in their survey responses that they injected their insulin less than once a day. Those 14 respondents were eliminated from further analysis, resulting in a total sample of 667.

*Web-based survey*

The web-based survey included items about demographics, health status, 12 diagnoses, IDS used, frequency of injection, and self-reported HbA1c. The survey also included items to assess attitudes about insulin therapy and IDS satisfaction (Table 1). Finally, participants were asked to evaluate their current insulin delivery system using the Insulin Injection Preference Questionnaire (IIP-Q).

TABLE 1. ASSESSMENTS OF ATTITUDES ABOUT INSULIN THERAPY AND SELF-DESCRIPTION REGARDING INSULIN THERAPY INCLUDED IN A WEB-BASED SURVEY OF 667 INDIVIDUALS WITH TYPE 2 DIABETES WHO USE INSULIN

Construct	Instructions	Example item(s)	Response sets	Scoring
Self-efficacy: confidence in managing insulin therapy	Thinking about your insulin therapy, please indicate the number that corresponds to your level of confidence in your ability to . . .	1. Take the correct dose of insulin each time 2. Avoid complications from your diabetes	Five-point scale "Not at all confident" (1) to "Extremely confident" (5)	Item scores summed and transformed to 0 to 100 scale
Perception of insulin therapy effectiveness	Thinking about your insulin therapy, how often did each of the following statements apply to you during the past month?	1. Made me feel better on a daily basis 2. Gave me consistent blood sugar control throughout the day	5-point scale from "Never" (1) to "Always" (5)	Item scores summed and transformed to 0 to 100 scale
Perceived value of insulin therapy	Thinking about your insulin therapy, how often did each of the following statements apply to you during the past month?	Caused me more work than it is worth	5-point scale from "Never" (5) to "always" (1)	Item score transformed to 0 to 100 scale
Self-description regarding insulin therapy	With regard to your insulin therapy, which of the following words best describe you?		Committed Tentative Hopeful Hassled Overwhelmed None of these	Descriptions are categorized as "Committed" or "Other"
IDS satisfaction	Based on your experience during the past 4 weeks with the IDS that you used—How satisfied were you with . . . ?	a. the way you used insulin b. the way you used insulin to control your blood sugars	7-point scale from "Very dissatisfied" (1) to "Very satisfied" (7)	Item score transformed to 0 to 100 scale

### IIP-q

The IIP-q consists of three subscales: Ease of Use, Activity Interference, and Social Acceptability. Respondents are asked the extent to which they agree that an IDS has features such as ease of selecting doses, convenience, and not noticeable to others when used. The IIP-q has demonstrated reliability and validity.<sup>25</sup> For purposes of this study, the IIP-q recall period was designated as 4 weeks, the response set was increased from a 5- to a 7-point scale ranging from "Strongly Disagree" (1) to "Strongly Agree" (7), and one item was eliminated.

### Statistical analysis

To provide uniform scoring across the measures of attitudes about insulin therapy and IIP-q subscales, all scores were converted to a 0 to 100 scale through a linear transformation ( $[\text{actual raw score} - \text{lowest possible score} / \text{raw score range}] \times 100$ ). Participant characteristics for two IDS subgroups (v/s users only and insulin pen users) and two HbA1c subgroups (participants who reported their HbA1c and those who did not) were compared using  $\chi^2$  test (categorical variables) or *t* test of independent means.

To address the first research question concerning the association between IDS satisfaction and individual characteristics, attitudes, and IIP-q scores, either Pearson Product Moment correlation coefficients were calculated, or a comparison of independent means (independent *t* tests or one-way analyses of variance) was performed.

To address the second research question concerning predictors of IDS satisfaction, stepwise linear regression analyses with IDS satisfaction as the dependent variable were performed. Independent variables were survey variables that were significantly ( $P < 0.05$ ) associated with IDS satisfaction.

## Results

### Study participants

The average age of all study participants ( $n = 667$ ) was approximately 57 years; 48% were male, and 88% were Caucasian (Table 2). Duration of diabetes for most participants was 5 or more years, and 85% had been on insulin therapy for 1 year or longer. Of the 12 diagnoses listed in the survey, the most frequently reported (in 15–45% of participants) were depression, uncontrolled hypertension, neuropathy, heart attack, congestive heart failure, and gallbladder disease. Seventeen percent of participants indicated that they had "none" of the 12 diagnoses.

The majority of participants (65%) selected the word "committed" to describe themselves with regard to their insulin therapy. Participants' attitudes toward insulin therapy were relatively positive, with mean scores above 60 (on a 0 to 100 scale) for the measures of self-efficacy, perceived effectiveness, and perceived value (Table 2).

About two-thirds (66%) of participants reported an HbA1c value; of those, only 35% reported an HbA1c  $< 7\%$ , the treatment goal endorsed by the American Diabetes Association.<sup>26</sup> Compared with those who did not report an HbA1c value, individuals who did report an HbA1c value tended to have longer duration of diabetes, use an insulin pen, inject more times a day, be employed full time, and have a higher income (all  $P < 0.05$ ). No significant differences were found in atti-

tudes about insulin therapy or IIP-q scores between the two groups.

The majority (73%) of participants used a v/s for insulin delivery, 14% used an insulin pen only, and 13% used both (Table 2). If participants used both an insulin pen and a v/s for insulin delivery, they were asked to refer only to the insulin pen as they completed the IIP-q and responded to the IDS satisfaction items; hereinafter, they are referred to as insulin pen users. Insulin pen users reported better health status and more full-time employment than v/s users; in addition, a greater proportion of insulin pen users than v/s users reported their HbA1c (Table 2).

### Research Question 1: What individual characteristics are associated with IDS satisfaction?

**Correlation analyses.** Significant ( $P < 0.05$ ) relationships were found between IDS satisfaction and age, self-reported health status, self-reported HbA1c, insulin therapy attitudes, and the three IIP-q subscale scores (Table 3). Greater IDS satisfaction was significantly associated with older age, a perception of better health status, self-reporting lower HbA1c, having more positive attitudes about insulin therapy, and a more positive evaluation of current IDS.

**Test of independent means.** No significant differences in IDS satisfaction were found between groups for the following variables: duration of diabetes, time on insulin therapy, injections per day, ethnicity, employment status, education, or income.

Significantly greater ( $P < 0.05$ ) IDS satisfaction was found to be associated with being female, self-reporting having either none of the survey diagnoses or having no diagnosis of neuropathy or depression, describing oneself as committed to insulin therapy, using an insulin pen, and reporting an HbA1c value (Table 4).

### Research Question 2: What individual characteristics and perceptions of features of an IDS significantly predict IDS satisfaction?

**Linear regression analyses.** Because self-reported HbA1c met the criteria for inclusion in the regression analyses (association with IDS satisfaction at the  $P < 0.05$  level) and data on self-reported HbA1c were available for only 438 respondents, the first stepwise linear regression analysis was performed with only those 438 participants. The results indicated that the best predictor of IDS satisfaction is perceived effectiveness ( $R^2 = 0.361$ ,  $P < 0.001$ ), followed by activity interference ( $R^2$  change = 0.091,  $P < 0.001$ ), perceived value ( $R^2$  change = 0.032,  $P < 0.001$ ), and self-description regarding insulin therapy ( $R^2$  change = 0.007,  $P = 0.016$ ), for a total  $R^2 = 0.49$ ,  $P < 0.001$  (Table 5).

Because self-reported HbA1c was not a significant predictor of IDS satisfaction in the first regression model, a second stepwise linear regression analysis using all 667 participants was performed. To account for differences in characteristics of participants who reported their HbA1c and those who did not, a new variable was added in the second stepwise regression analysis to represent whether participants reported their HbA1c.

Results of the second stepwise linear regression analysis indicated that the best predictor of IDS satisfaction was

TABLE 2. CHARACTERISTICS AND MEAN ATTITUDE ABOUT INSULIN THERAPY SCORES OF 667 INDIVIDUALS WITH TYPE 2 DIABETES WHO USE INSULIN AND WHO PARTICIPATED IN A WEB-BASED SURVEY BY IDS USED

	<i>v/s only</i> (n = 489)		<i>Insulin pen</i> (n = 178)		<i>Total</i> (n = 667)		<i>P value</i>
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	
Age (years)	57.1	9.3	56.3	10.0	56.9	9.5	0.31
Self-reported health status <sup>a</sup>	2.4	0.8	2.6	0.9	2.4	0.9	0.02
	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>	<i>P value</i>
Male	239	49	79	44	318	48	0.34
Caucasian	432	88	155	87	587	88	0.69
Duration of diabetes							
6 months to <5 years	68	14	22	12	90	14	0.86
5 years to <10 years	195	40	71	40	266	40	
≥10 years	226	46	85	48	311	47	
Duration of insulin therapy							
3 months to <1 year	66	14	32	18	98	15	0.30
1 year to <5 years	260	53	86	48	346	52	
5 years to <10 years	163	33	60	34	223	33	
Number of injections per day							
Once a day	190	39	28	16	218	33	<0.001
Twice a day	165	34	73	41	238	36	
More than twice a day	134	27	77	43	211	32	
Self-reported diagnoses (yes)							
Depression	227	46	70	39	297	45	0.11
Uncontrolled hypertension	179	37	59	33	238	36	0.47
Neuropathy	180	37	52	29	232	35	0.08
Heart attack	95	19	24	14	119	18	0.09
Congestive heart failure	85	17	23	13	108	16	0.19
Gallbladder disease	74	15	27	15	101	15	1.00
None of 12 diagnoses	73	15	37	21	110	17	0.08
Highest educational level							
High school or less	91	19	38	21	129	19	0.14
Some college	250	51	75	42	325	49	
Undergraduate degree or some graduate school	93	19	36	20	129	19	
Postgraduate degree	55	11	29	16	84	13	
Full-time employment	125	26	64	36	189	28	0.01
Income (n = 600)							
\$24,999 or less	120	27	39	25	159	27	0.06
\$25,000–\$49,999	156	35	43	28	199	33	
\$50,000–\$74,999	95	21	34	22	129	22	
\$75,000 or more	73	16	40	26	113	19	
Attitudes about insulin therapy							
Self-description							
Committed	312	64	120	67	432	65	0.30
Tentative	30	6	8	5	38	6	
Hopeful	81	17	21	12	102	15	
Hassled	33	7	10	6	43	6	
Overwhelmed	20	4	10	6	30	5	
None of these	13	3	9	5	22	3	
	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	<i>P value</i>
Self-efficacy <sup>b</sup>	64.2	21.8	65.3	22.5	64.5	22.0	0.55
Perceived effectiveness <sup>b</sup>	67.2	20.6	69.0	20.5	67.7	20.6	0.31
Perceived value <sup>b</sup>	72.7	26.3	73.3	26.0	72.8	26.2	0.77
	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>	<i>Number</i>	<i>%</i>	<i>P value</i>
Self-reported HbA1c							
Reported HbA1c (yes, %)	308	63	130	73	438	66	0.02
HbA1c <7.0% (yes, %)	101	33	52	40	153	35	0.16
HbA1c (%) (mean, SD)	7.6	1.5	7.3	1.2	7.5	1.4	0.02

Some total percentages may not equal 100% due to rounding error. Differences in categorical variables (e.g., income, education) between v/s users and insulin pen users were tested using a  $\chi^2$  test. Differences in means of continuous variables (e.g., age, attitudes) between v/s users and insulin pen users were tested using comparisons of independent means (*t* test or one-way analysis of variance).

<sup>a</sup>Scores range from 1 to 5. Higher scores correspond to better perceived health status.

<sup>b</sup>Scores range from 0 to 100. Higher scores correspond to a more positive attitude.

perceived effectiveness ( $R^2=0.401, P<0.001$ ), followed by activity interference ( $R^2$  change = 0.103,  $P<0.001$ ), perceived value ( $R^2$  change = 0.028,  $P<0.001$ ), and self-description regarding insulin therapy ( $R^2$  change = 0.012,  $P<0.001$ ). However, in this second model, predictors of IDS satisfaction also included the variable indicating whether participants reported their HbA1c ( $R^2$  change = 0.005,  $P=0.005$ ), gender ( $R^2$  change = 0.003,  $P=0.028$ ), and ease of use ( $R^2$  change = 0.003,  $P=0.028$ ), for a total  $R^2=0.556$  ( $P<0.001$ ).

**Discussion**

This study aimed to identify those characteristics of individuals with type 2 diabetes using insulin that influence satisfaction with their IDS. It was hypothesized that these characteristics could assist in identifying patients who would likely benefit from use of an insulin pen. This study is different from preceding studies that compare IDSs in that (1) it recruited from a national sample of individuals with type 2 diabetes who use insulin and (2) it examined associations between participants' satisfaction with their IDS and variables shown to contribute to other types of satisfaction or preferences, such as satisfaction with physician relationship, dietary management, diabetes treatment, and insulin therapy.<sup>20-24</sup>

Indicators of health status, both mental (e.g., depression) and physical (e.g., neuropathy), were significantly associated with IDS satisfaction, independent of the type of IDS used. Depression has been shown to affect not only different types of satisfaction but also medication adherence.<sup>19,27-31</sup> Symptoms associated with depression, such as apathy toward diabetes management,<sup>32</sup> may contribute to a poor perception of an IDS independent of the system used. For such individuals, their depression should be addressed before determining which IDS best fits their needs.<sup>19</sup>

Brod et al.<sup>24</sup> identified neuropathy as the single best predictor of insulin therapy satisfaction. It is possible that pain and other symptoms of neuropathy make any injectable IDS difficult for patients with neuropathy. Alternative methods of delivery currently under development (inhaled, intranasal, transdermal, and oral<sup>3</sup>) may be more appropriate for these patients. Despite significant associations found between

health status indicators and participants' evaluations of and satisfaction with their IDS, none of these variables emerged as significant predictors of IDS satisfaction. This result may have been due to the fact that these health status variables (such as self-reported health status and depression) were moderately correlated with variables that did predict IDS satisfaction (data not shown) and, therefore, did not provide unique variance.

For the 438 participants who self-reported their HbA1c, relatively small but significant associations were found between their reported HbA1c values and IDS satisfaction. Yet, consistent with the study of insulin therapy satisfaction by Brod et al.<sup>24</sup> using an HbA1c laboratory value, HbA1c lost its significance when combined with other variables. Like health status indicators, self-reported HbA1c is moderately correlated with variables that did significantly predict IDS satisfaction.

Not surprisingly, perceived effectiveness and value, along with self-efficacy and commitment to insulin therapy, were found to be significantly associated with IDS satisfaction. A previous study has indicated that perceived effectiveness is a key driver of diabetes treatment satisfaction and preference.<sup>33,34</sup> Confidence or self-efficacy has been purported to contribute to improved diabetes self management.<sup>19,35-37</sup> Savoca et al.<sup>38</sup> used qualitative methods to contrast the experience and attitudes of people at the extremes of glycemic control. The individuals labeled as "committed" were described by the authors as consistent in their adherence to dietary, lifestyle, glucose monitoring, and medication recommendations and were consequently in better glycemic control than other groups of individuals (these other groups were characterized as tentative,

TABLE 3. CORRELATIONS (R) BETWEEN IDS SATISFACTION AND PATIENT CHARACTERISTICS, ATTITUDE SCORES, AND IIP-Q SCORES OBTAINED THROUGH A WEB-BASED SURVEY OF 667 INDIVIDUALS WITH TYPE 2 DIABETES WHO USE INSULIN

Correlate	Correlation with IDS satisfaction (r)
Age	0.11*
Self-reported health status	0.20**
Self-efficacy with regard to insulin therapy	0.49**
Perceived effectiveness of insulin therapy	0.63**
Perceived value of insulin therapy	0.46**
Self-reported HbA1c <sup>a</sup>	-0.31**
Ease of use	0.54**
Activity interference	0.53**
Social acceptability	0.44**

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

<sup>a</sup> $n = 438$ .

TABLE 4. MEAN IDS SATISFACTION SCORES ACROSS CHARACTERISTICS OBTAINED THROUGH A WEB-BASED SURVEY OF 667 INDIVIDUALS WITH TYPE 2 DIABETES WHO USE INSULIN

Independent variable	IDS satisfaction [mean (SD)]	P value
Gender		
Male (n = 318)	67.2 (24.6)	0.027
Female (n = 349)	71.4 (24.0)	
Diagnosis of depression		
Yes (n = 297)	65.5 (25.5)	<0.001
No (n = 370)	72.6 (23.0)	
Diagnosis of nephropathy		
Yes (n = 232)	66.9 (24.7)	0.049
No (n = 435)	70.8 (24.1)	
Self-report of 12 diagnoses		
One or more diagnoses (n = 557)	68.4 (24.4)	0.013
None of the 12 diagnoses (n = 110)	74.7 (23.8)	
Self-description regarding insulin therapy		
Other (n = 235)	55.7 (26.0)	<0.001
Committed (n = 432)	76.9 (19.8)	
Insulin delivery system		
v/s only (n = 489)	66.9 (24.6)	<0.001
Insulin pen (n = 178)	76.5 (22.3)	
Self-reported HbA1c		
No (n = 229)	66.0 (26.0)	0.010
Yes (n = 438)	71.2 (23.3)	

TABLE 5. STANDARDIZED  $\beta$  COEFFICIENTS FOR VARIABLES IN STEPWISE LINEAR REGRESSION MODELS USING IDS SATISFACTION AS THE DEPENDENT VARIABLE AND VARIABLES ASSESSED THROUGH A WEB-BASED SURVEY OF 667 INDIVIDUALS WITH TYPE 2 DIABETES WHO USE INSULIN

Independent variable	Analysis with	
	Study participants who reported HbA1c (n = 438)	All study participants (n = 667)
1. Perceived effectiveness of insulin therapy	0.41**	0.39***
2. Activity interference	0.27**	0.24***
3. Perceived value of insulin therapy	0.18**	0.16***
4. Self-described as "Committed" (yes = 1, no = 0)	0.09*	0.13***
5. Report HbA1c (yes = 1, no = 0)		0.07**
6. Gender (male = 1, female = 0)		-0.06*
7. Ease of use		0.09*
Total R <sup>2</sup>	0.49***	0.56***

Significant at the \* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$  level.

hopeful, hassled, and overwhelmed). Moreover, an optimistic attitude is believed to differentiate between those patients with diabetes who are active problem solvers<sup>31,37,39</sup> in their diabetes management and those who are not. It may be that those individuals who described themselves as "committed" have a more positive attitude about their health and their insulin therapy, which translates into greater satisfaction independent of the IDS used.

Results of the linear regression analysis that was limited to those participants reporting an HbA1c value ( $n = 438$ ) identified insulin therapy attitudes and perceptions of IDS features as predictors of IDS satisfaction independent of IDS used. When participants who did not report an HbA1c value were added to the analysis, the first four predictors of IDS satisfaction (perceived effectiveness, activity interference, perceived value, and commitment to insulin therapy) remained significant predictors. However, three additional variables were also identified as significant predictors: gender, report of HbA1c, and the extent to which participants agreed that their IDS was easy to use.

In a review of the quality of life literature, Rubin and Peyrot<sup>40</sup> also found gender differences in treatment satisfaction. In contrast to this study, they reported that males were more satisfied with their treatment regimens and perceived less impact of treatment regimen on their leisure activities than females. Further research is needed to understand whether gender difference in IDS satisfaction is clinically meaningful.

In a cross-sectional study of individuals with type 2 diabetes in the United States, Heisler et al.<sup>41</sup> found that only one-third could report their HbA1c values and that only a quarter could do so accurately. Those individuals who knew their HbA1c were better educated and reported a better understanding of their diabetes care. In this study, approximately two-thirds of respondents reported their HbA1c value, but the

accuracy of those values is unknown. It was beyond the scope of this study to compare the differences in understanding of diabetes care between those who reported their HbA1c and those who did not. This study did show, however, that purported knowledge of HbA1c played a significant role in IDS satisfaction. Perhaps those who reported their HbA1c have a better understanding of their disease progression and are more accepting of what is required of them to manage their diabetes in terms of diet, exercise, self-testing, and medication adherence. If these participants believe an IDS is a tool to assist them in achieving glycemic control, it may also lead to greater IDS satisfaction. Further research is needed to understand this unanticipated finding.

Similar to studies showing greater patient satisfaction with or preference for an insulin pen over a v/s,<sup>6-11</sup> significant differences were found in IDS satisfaction between v/s only users and insulin pen users. However, IDS type did not emerge as a significant predictor of IDS satisfaction. This result suggests that not all individuals with type 2 diabetes who use insulin would be more satisfied with or would benefit from using an insulin pen.

### Limitations

This was a web-based survey, and recruitment was from a population that has shown interest in participating in surveys; thus findings cannot be generalized to the entire U.S. population of individuals with type 2 diabetes. Effort was made to ensure that all regions of the country were represented, but this was an unweighted sample. Other limitations include the fact that diagnoses and HbA1c were self-reported and could not be confirmed.

### Conclusions

Because many physicians are reluctant to prescribe pens, it is important to identify characteristics and/or attitudes of individuals with type 2 diabetes who might benefit from using an insulin pen. Although the results of this study did not definitively identify a target population for insulin pens, it does provide an initial step in this identification. These results suggest that individuals with mental health or psychosocial issues need to have these issues addressed prior to consideration of IDS. Further, those individuals with physical issues such as neuropathy may find both v/s and insulin pen challenging and would be better served using non-injectable alternatives as they become available. However, individuals whose attitudes indicate they value their insulin therapy and are committed to their diabetes management may benefit from insulin pen use. The reduced burden of treatment derived from a pen<sup>2,12</sup> may allow these individuals to achieve and/or maintain the glycemic control they need for improved patient outcomes.<sup>42</sup>

### Acknowledgments

This study was funded by Eli Lilly and Company. The authors gratefully acknowledge the editorial assistance of Pam Erickson and Karen Shields.

### Author Disclosure Statement

R.P.H. is an employee and stockholder of Eli Lilly and Company, which develops and markets products for the

treatment of diabetes. J.T.F. is a consultant to Eli Lilly and Company.

## References

- Koro CE, Bowlin SJ, Bourgeois N, Fedder DO: Glycemic control from 1988 to 2000 among U.S. adults diagnosed with type 2 diabetes: a preliminary report. *Diabetes Care* 2004;27:17–20.
- Da Costa S, Brackenridge B, Hicks D: A comparison of insulin pen use in the United States and the United Kingdom. *Diabetes Educ* 2002;28:52–56, 59–60.
- Flood T: Advances in insulin delivery systems and devices: beyond the vial and syringe. *Insulin* 2006;1:99–108.
- Bhargava A: Insulin therapy: the question this issue. *Insulin* 2007;2:37–39.
- Magnotti MA, Rayfield EJ: An update on insulin injection devices. *Insulin* 2007;2:173–181.
- Stockl K, Ory C, Vanderplas A, Nicklasson L, Lyness W, Cobden D, Chang E: An evaluation of patient preference for an alternative insulin delivery system compared to standard vial and syringe. *Curr Med Res Opin* 2007;23:133–146.
- Shelmet J, Schwartz S, Cappleman J, Peterson G, Skovlund S, Lytzen L, Nicklasson L, Liang J, Lyness W; InnoLet Study Group: Preference and resource utilization in elderly patients: InnoLet versus vial/syringe. *Diabetes Res Clin Pract* 2004;63:27–35.
- Korytkowski M, Bell D, Jacobsen C, Suwannasari R; FlexPen Study Team: A multicenter, randomized, open-label, comparative, two-period crossover trial of preference, efficacy, and safety profiles of a prefilled, disposable pen and conventional vial/syringe for insulin injection in patients with type 1 or 2 diabetes mellitus. *Clin Ther* 2003;25:2836–2848.
- Kadiri A, Chraïbi A, Marouan F, Ababou MR, el Guermai N, Wadjinny A, Kerfati A, Douiri M, Bensouda JD, Belkhadir J, Arvanitis Y: Comparison of NovoPen 3 and syringes/vials in the acceptance of insulin therapy in NIDDM patients with secondary failure to oral hypoglycaemic agents. *Diabetes Res Clin Pract* 1998;41:15–23.
- Coscelli C, Lostia S, Lunetta M, Nosari I, Coronel GA: Safety, efficacy, acceptability of a pre-filled insulin pen in diabetic patients over 60 years old. *Diabetes Res Clin Pract* 1995;28:173–177.
- Dunbar JM, Madden PM, Gleeson DT, Fiad TM, McKenna TJ: Premixed insulin preparations in pen syringes maintain glycemic control and are preferred by patients. *Diabetes Care* 1994;17:874–878.
- Rubin RR, Peyrot M: Factors affecting use of insulin pens by patients with type 2 diabetes. *Diabetes Care* 2008;31:430–432.
- Anderson RT, Marrero D, Skovlund SE, Cramer J, Schwartz S: Self-reported compliance with insulin injection therapy in subjects with type 1 and 2 diabetes [abstract]. *Diabetologia* 2003;46(Suppl 2):A275.
- Pladevall M, Williams LK, Potts LA, Divine G, Xi H, Lafata JE: Clinical outcomes and adherence to medications measured by claims data in patients with diabetes. *Diabetes Care* 2004;27:2800–2805.
- Krapek K, King K, Warren SS, George KG, Caputo DA, Mihelich K, Holst EM, Nichol MB, Shi SG, Livengood KB, Walden S, Lubowski TJ: Medication adherence and associated hemoglobin A1c in type 2 diabetes. *Ann Pharmacother* 2004;38:1357–1362.
- Hill-Briggs F, Gary TL, Bone LR, Hill MN, Levine DM, Brancati FL: Medication adherence and diabetes control in urban African Americans with type 2 diabetes. *Health Psychol* 2005;24:349–357.
- Rhee MK, Slocum W, Ziemer DC, Culler SD, Cook CB, El-Kebbi IM, Gallina DL, Barnes C, Phillips LS: Patient adherence improves glycemic control. *Diabetes Educ* 2005;31:240–250.
- Odegard PS, Capoccia K: Medication taking and diabetes: a systematic review of the literature. *Diabetes Educ* 2007;33:1014–1029; discussion 1030–1031.
- Rubin RR: Adherence to pharmacologic therapy in patients with type 2 diabetes mellitus. *Am J Med* 2005;118(Suppl 5A):27S–34S.
- Franciosi M, Pellegrini F, De Berardis G, Belfiglio M, Di Nardo B, Greenfield S, Kaplan SH, Sacco M, Tognoni G, Valentini M, Nicolucci A; The QuED Study Group—Quality of Care and Outcomes in Type 2 Diabetes: Correlates of satisfaction for the relationship with their physician in type 2 diabetic patients. *Diabetes Res Clin Pract* 2004;66:277–286.
- Ahlgren SS, Shultz JA, Massey LK, Hicks BC, Wysham C: Development of a preliminary diabetes dietary satisfaction and outcomes measure for patients with type 2 diabetes. *Qual Life Res* 2004;13:819–832.
- Hirsch A, Bartholomae C, Volmer T: Dimensions of quality of life in people with non-insulin-dependent diabetes. *Qual Life Res* 2000;9:207–218.
- Redekop WK, Koopmanschap MA, Stolk RP, Rutten GE, Wolffenbuttel BH, Niessen LW: Health-related quality of life and treatment satisfaction in Dutch patients with type 2 diabetes. *Diabetes Care* 2002;25:458–463.
- Brod M, Cobden D, Lammert M, Bushnell D, Raskin P: Examining correlates of treatment satisfaction for injectable insulin in type 2 diabetes: lessons learned from a clinical trial comparing biphasic and basal analogues. *Health Qual Life Outcomes* 2007;5:8.
- Szeinbach SL, Barnes JH, Summers KH, Lenox SM: Development of an instrument to assess expectations of and preference for an insulin injection pen compared with the vial and syringe. *Clin Ther* 2004;26:590–597.
- Clinical practice recommendations. *Diabetes Care* 2008;31(Suppl 1):S3–S4.
- Lin EH, Katon W, Von Korff M, Rutter C, Simon GE, Oliver M, Ciechanowski P, Ludman EJ, Bush T, Young B: Relationship of depression and diabetes self-care, medication adherence, and preventive care. *Diabetes Care* 2004;27:2154–2160.
- Kilbourne AM, Reynolds CF 3<sup>rd</sup>, Good CB, Sereika SM, Justice AC, Fine MJ: How does depression influence diabetes medication adherence in older patients? *Am J Geriatr Psychiatry* 2005;13:202–210.
- Kalsekar ID, Madhavan SS, Amonkar MM, Makela EH, Scott VG, Douglas SM, Elswick BL: Depression in patients with type 2 diabetes: impact on adherence to oral hypoglycemic agents. *Ann Pharmacother* 2006;40:605–611.
- Gonzalez JS, Safren SA, Cagliero E, Wexler DJ, Delahanty L, Wittenberg E, Blais MA, Meigs JB, Grant RW: Depression, self-care, and medication adherence in type 2 diabetes: relationships across the full range of symptom severity. *Diabetes Care* 2007;30:2222–2227.
- Fisher EB, Thorpe CT, Devellis BM, Devellis RF: Healthy coping, negative emotions, and diabetes management: a systematic review and appraisal. *Diabetes Educ* 2007;33:1080–1103; discussion 1104–1106.
- Padala PR, Desouza CV, Almeida S, Shivaswamy V, Ariyaratna K, Rouse L, Burke WJ, Petty F: The impact of apathy on glycemic control in diabetes: a cross-sectional study. *Diabetes Res Clin Pract* 2008;79:37–41.

33. McHorney CA, Hayes RP, Bowman L, Myers J: Drivers of treatment preference among individuals with type 2 diabetes [abstract]. *Value Health* 2004;7:235.
34. Hayes RP, Bowman L, Monahan PO, Marrero DG, McHorney CA: Understanding diabetes medications from the perspective of patients with type 2 diabetes: prerequisite to medication concordance. *Diabetes Educ* 2006;32:404–414.
35. Nelson KM, McFarland L, Reiber G: Factors influencing disease self-management among veterans with diabetes and poor glycemic control. *J Gen Intern Med* 2007;22:442–447.
36. Sarkar U, Fisher L, Schillinger D: Is self-efficacy associated with diabetes self-management across race/ethnicity and health literacy? *Diabetes Care* 2006;29:823–829.
37. Rose M, Fliege H, Hildebrandt M, Schirop T, Klapp BF: The network of psychological variables in patients with diabetes and their importance for quality of life and metabolic control. *Diabetes Care* 2002;25:35–42.
38. Savoca MR, Miller CK, Quandt SA: Profiles of people with type 2 diabetes mellitus: the extremes of glycemic control. *Soc Sci Med* 2004;58:2655–2666.
39. O'Connor PJ, Crabtree BF, Yanoshik MK: Differences between diabetic patients who do and do not respond to a diabetes care intervention: a qualitative analysis. *Fam Med* 1997;29:424–428.
40. Rubin RR, Peyrot M: Quality of life and diabetes. *Diabetes Metab Res Rev* 1999;15:205–218.
41. Heisler M, Piette JD, Spencer M, Kieffer E, Vijan S: The relationship between knowledge of recent HbA1c values and diabetes care understanding and self-management. *Diabetes Care* 2005;28:816–822.
42. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type diabetes (UKPDS 33). UK Prospective Diabetes Study (UKPDS) Group. *Lancet* 1998;352:837–853.

Address correspondence to:

*Risa P. Hayes, Ph.D.*

*Global Health Outcomes*

*Eli Lilly and Company*

*Lilly Corporate Center, DC 1833*

*Indianapolis, IN 46285*

*E-mail: hayes\_clarice@lilly.com*



**This article has been cited by:**

1. Risa P. Hayes , April N. Naegeli . 2010. The Contribution of Pretreatment Expectations and Expectation-Perception Difference to Change in Treatment Satisfaction and End Point Treatment Satisfaction in the Context of Initiation of Inhaled Insulin Therapy in Patients with Type 2 DiabetesThe Contribution of Pretreatment Expectations and Expectation-Perception Difference to Change in Treatment Satisfaction and End Point Treatment Satisfaction in the Context of Initiation of Inhaled Insulin Therapy in Patients with Type 2 Diabetes. *Diabetes Technology Therapeutics* **12**:6, 447-453. [[Abstract](#)] [[Full Text](#)] [[PDF](#)] [[PDF Plus](#)]
2. 2010. Current literature in diabetes. *Diabetes/Metabolism Research and Reviews* **26**:1, i-ix. [[CrossRef](#)]