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Predicting Adherence with Diabetic Eye Exams: Development of the Compliance with Annual Diabetic Eye Exams Survey

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Abstract

Objective—To identify variables that predict adherence with annual eye exams using the Compliance with Annual Diabetic Eye Exams Survey (CADEES), a new questionnaire designed to measure health beliefs related to diabetic retinopathy and annual eye exams.

Design—Questionnaire development.

Participants—Three hundred and sixteen adults with diabetes.

Methods—We developed the CADEES based on a review of the literature, the framework of the Health Belief Model, expert opinion, and pilot study data. To examine content validity, we analyzed participant responses to an open-ended question asking for reasons why people do not obtain annual eye exams; we then used these results to determine whether there were content areas missing from the survey. We evaluated construct validity with principal components analysis and examined internal consistency with Cronbach's alpha. To assess predictive validity, we used multivariate logistic regression with self-reported adherence as the dependent variable.

Main Outcome Measures—Associations with self-reported adherence (defined as having a dilated eye exam in the past year).

Results—The content analysis showed that CADEES items covered 89% of the reasons given by participants for not obtaining an annual eye exam. The principal components analysis identified three informative components comprising 32% of the variance, and reliability analyses showed acceptable Cronbach's alphas (>0.60) for all three components. Multivariate logistic regression modeling revealed several significant predictors of adherence, including beliefs concerning: whether insurance covered most of the eye exam cost (p<0.01), whether there were general barriers that make it difficult to get an eye exam (p<0.01), whether obtaining an eye exam was a top priority (p=0.02), and whether diabetic eye disease can be seen with an exam (p=0.05). Lower

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hemoglobin A1c levels (p<0.01), having insurance (p=0.01), and a longer duration of diabetes (p=0.02) were also associated with adherence. A multivariate model containing CADEES items and demographic variables classified cases with 72% accuracy and explained approximately 24% of the variance in adherence.

Conclusions—The CADEES showed good content and predictive validity. While future research is needed before finalizing a shorter version of the survey, researchers and clinicians may be able to improve adherence by (1) counseling newly diagnosed patients, as well as those with uncontrolled blood sugar control, on the importance of annual eye exams, and (2) discussing perceived barriers and misconceptions related to obtaining annual eye exams.

Diabetes is a growing public health concern. Huang and colleagues estimate that approximately 44 million people in the United States will have diabetes by the year 2034.[1] Diabetes commonly results in retinopathy, a disease affecting approximately 84% of patients on insulin with a duration of diabetes up to 19 years.[2] In its advanced stages, diabetic retinopathy can lead to vision loss and/or blindness. Because it is often asymptomatic in its early stages, best practice guidelines recommend that people with diabetes have an annual eye exam to screen for retinopathy.[3] These exams allow for early detection and timely treatments that are 90% effective in reducing the likelihood of severe vision loss.[2] Despite this recommendation, only half of those diagnosed with diabetes obtain an annual eye exam.[4]

A few studies have examined the personal characteristics and clinical variables associated with obtaining annual eye exams. They show that adherence is associated with better blood sugar control,[5] older age,[5–7] having health insurance coverage,[5, 7] and a longer duration of diabetes.[7, 8] In recent years, the adherence literature has called for a patient-centered approach to better understand adherence with recommended health behaviors.[9, 10] This trend is also evident in research examining adherence with annual eye exams, with investigators placing a greater emphasis on patient knowledge, attitudes, and health beliefs. While these studies have mainly focused on the barriers[6, 11–14] and benefits[11, 14] associated with annual eye exams, health behavior models suggest that other factors may also play a role.[15, 16]

To expand the evidence in this area, we used the theoretical framework of the Health Belief Model[17] to create the Compliance with Annual Diabetic Eye Examinations Survey (CADEES). The Health Belief Model has been used to explain and predict a wide variety of health behaviors[15, 18] and posits that behavior is dependent on six constructs: perceived severity, perceived susceptibility, perceived benefits, perceived barriers, cues to action, and self-efficacy. While the factors associated with obtaining annual eye exams are consistent with the conceptual framework of the Health Belief Model,[8] we are not aware of previous research that has used this framework to identify factors related to adherence with annual eye exam recommendations.

In this report we describe how the CADEES was developed, and we evaluate the content, construct, and predictive validity of this tool with data from a large, racially diverse sample. Our ultimate goal is to develop a brief survey clinicians can use to tailor their interactions with patients, supporting their efforts to improve patient adherence with annual eye exams.

METHODS

Participants

We recruited adults with diabetes enrolled in an ongoing clinical trial examining the effectiveness of an ophthalmic telemedicine program in two primary care clinics.[19] We randomized participants to one of two groups: (1) telemedicine with a nonmydriatic camera, or (2) traditional surveillance with an eye care provider. After two years of enrollment, we offered telemedicine screenings to those in the traditional surveillance group. At the time the CADEES was administered, all participants had been enrolled in the trial for at least two years.

The Portland Area Indian Health Service Institutional Review Board reviewed and approved the study protocol. All participants signed a consent form. The protocol was Health Insurance Portability and Accountability Act (HIPAA) compliant, and the study was conducted in accordance with the tenets of the Declaration of Helsinki. Participants received $25 for completing the survey.

Development and Administration of the CADEES

We developed the CADEES in three stages. In the first stage, we created items for the survey based on expert opinion and a review of the literature.[5–17, 20] Demographic variables included sex, age, race/ethnicity, insurance status, education level, marital status, and income. Clinical variables included hemoglobin A1c level, years diagnosed with diabetes, type of diabetes, and dilated eye exam history. The health belief variables included statements related to the six constructs of the Health Belief Model (severity, susceptibility, benefits, barriers, cues to action, and self-efficacy), as well as items the authors identified as potentially important based on previous adherence studies (e.g., satisfaction with eye care provider,[10] depression[20]).

The second stage of development involved pilot testing. We surveyed 100 patients with diabetes to assess understandability, identify scaling issues, and evaluate the need for additional items. Trained interviewers administered the pilot study questionnaire using a standardized script. Interviewers took notes while administering the survey to evaluate the clarity of items. Based on our analysis of these preliminary data, three items were removed because respondents judged them to be repetitive, four items were reworded to improve clarity, and three items were added to cover omitted themes identified in answers to an open-ended question. The final version of the CADEES included 13 clinical and demographic items, 1 yes/no question, 1 open-ended question, and 43 health belief statements. For the health belief items, participants responded using a 5-point Likert scale ranging from Strongly Disagree to Strongly Agree. We measured adherence with the question “Have you ever had an exam when the doctor put drops in your eyes that made your pupils large? *If yes*, when was your last exam like that?” The complete questionnaire can be viewed at https://www.deverseye.org/CADEES/CADEES.pdf (last accessed on October 10, 2013).

In the third step of survey development, the final version of the CADEES was administered to 316 adults. Most participants (260/316, 82%) completed the survey themselves; interviewers administered the survey for the remaining participants (56/316, 18%), either in

person (when the participant required assistance reading the printed questionnaire because of poor vision or literacy) or by telephone.

Data Analysis

We used SPSS Version 19.0 (IBM Corp. Armonk, New York) to conduct all statistical analyses.

To evaluate content validity, the extent to which a specific domain of content is captured by a particular set of items,[21, 22] we examined responses to the last question on the CADEES: "We are interested in why some people do not have yearly eye exams. Can you think of any reasons we did not ask about in this survey?" We first categorized participant responses as either substantive (e.g., "the biggest problem is the expense") or non-substantive (e.g., "no", "covered reasons well"). Two raters then read the substantive responses and divided each into individual statements based on the reasons listed (e.g., the response "money, no car, too busy" was divided into three separate statements). We calculated initial observed agreement between the raters before they discussed coding differences and reached a consensus.

We then followed the steps outlined by Weber[23] to create and test a coding scheme for categorizing the reasons provided by participants. We first created categories to reflect the theme/concept of each individual statement. The same two raters independently coded random samples of the statements to refine category definitions, and they continued this process until they reached a minimum observed agreement level of 80%. The raters then coded the full sample of statements for (1) category and (2) whether a CADEES item covered the reason for nonadherence. We calculated observed agreement between the two raters for both measures before the raters discussed differences and reached a consensus.

Construct validity refers to the extent to which variables relate to one another as predicted by theory.[21, 22] We explored the structure of the CADEES with principal components analysis[24] (PCA) and evaluated whether the resulting components were consistent with the constructs of the Health Belief Model. We determined the number of components to retain by examining the scree plot and the amount of variance explained by each component in the initial solution. We then ran a second PCA using varimax rotation and specified the number of components to extract. We examined various factor loading cutoffs[21] and selected ≥ 0.50; using this cutoff, no items also had a factor loading ≥0.30 for a second component, indicating good discriminatory power.[25] To assess internal consistency, we ran reliability analyses and calculated Cronbach's alpha[22] for each of the extracted PCA components. We then reviewed item-total statistics and removed items if the Cronbach's alpha value increased when the item was deleted.

We used adherence to assess predictive validity,[21] and defined patients as 'adherent' if they reported having a dilated eye exam in the past year. We used a three-step process to identify the variables associated with adherence. We first used univariate logistic regression, with self-reported adherence as the dependent variable, to determine whether each variable was independently associated with adherence. Second, we entered the variables with significant univariate associations ($p \leq 0.05$) into a multivariate logistic regression model and used stepwise backwards elimination to identify the variables that significantly predicted

adherence; this step was done separately for component scores, individual CADEES items, and demographic items. Lastly, we created two final models that combined health belief and demographic variables. The first model contained significant demographic and component score predictors ("component model"), and the second model contained significant demographic and individual CADEES item predictors ("individual item model"). We built these models separately because of overlap between the CADEES items that comprised component scores and the individual CADEES items that predicted adherence. We included participants in multivariate analyses if they responded to all variables included in the model.

At the time the CADEES was administered to study participants, both groups had access to telemedicine. Even so, the amount of exposure to telemedicine differed between the groups and may have led to differences in survey responses. To determine whether differences existed between the telemedicine and traditional surveillance groups, we compared responses to each CADEES items using independent samples *t*-tests.

RESULTS

Participants

Table 1 presents the demographic characteristics of the sample. Approximately 70% of participants reported a non-white race/ethnicity, and one third had no health insurance. The average time diagnosed with diabetes was over 12 years, and the mean hemoglobin A1c level was almost 8%. Roughly 90% reported having Type 2 diabetes, 7% reported having Type 1 diabetes, and 3% were unsure of their diagnosis. Fifty-eight percent (58%) reported having a dilated eye exam in the past year.

Content Validity

Thirty-eight percent (38%, 121/316) of participants provided a substantive response to the open-ended question on the final version of the CADEES. Initial observed agreement between the two raters was 89% (108/121) when coding for number of reasons contained in each participant response. The two raters were able to reach agreement after discussion for the remaining 13 cases. In total, the 121 participants provided 196 reasons why people do not obtain annual eye exams.

Review of the 196 reasons resulted in the creation of 17 categories (listed below). When coding the full sample of responses, observed agreement for category assignment was 92%. After consensus was reached, responses were categorized as follows: 27.6% (54/196) cost, 9.7% (19/196) transportation, 8.7% (17/196) insurance, 8.7% (17/196) other, 8.2% (16/196) doesn't know importance, 6.6% (13/196) time, 5.1% (10/196) other commitments, 4.1% (8/196) doesn't care, 4.1% (8/196) forgetting, 3.6% (7/196) afraid, 3.1% (6/196) lazy, 2.6% (5/196) no vision problems, 2.6% (5/196) procrastination, 2.0% (4/196) accessibility, 1.5% (3/196) health issues, 1.0% (2/196) dislikes exam, and 1.0% (2/196) provider availability.

Initial observed agreement for assigned CADEES item(s) was 81%. For the 19% of cases in which coding differed, 12% stemmed from disagreement regarding whether the CADEES had an item that covered the reason listed, while in the other 7% of cases, both raters agreed that at least one CADEES item covered the reason given but did not agree on which item(s).

After reaching consensus, the raters agreed that 89% (174/196) of reasons provided were covered by items on the CADEES and 11% (22/196) were not covered. The items that were not covered comprised the categories procrastination (5/22), forgetting (3/22), provider availability (2/22) and other (12/22); the "other" category included items that could not be categorized based on a common theme.

Floor/Ceiling Effects

We observed no floor or ceiling effects (defined as ≥ 90% of participants indicating 1 or 5 on the response scale) for any of the CADEES items.

Construct Validity

Principal Components Analysis—A PCA on the 43 health belief items resulted in the extraction of 13 components that accounted for 63% of the variance. However, after reviewing the variance explained by each component and the scree plot, we retained three components for further analysis. The three-component solution accounted for 32% of the variance. Table 2 presents the 24 items that loaded onto the three components when applying the factor loading cutoff of 0.50. The first and second components included items from multiple constructs of the Health Belief Model. The first component was mostly comprised of items created to measure the severity, benefits and self-efficacy constructs. Although the second component contained items from three categories, it appears to have a general health theme that may be tapping a broader "susceptibility" construct. The third component clearly represents a "barriers" construct, as all five items were created to measure that construct of the Health Belief Model.

Reliability Analyses—We conducted reliability analyses on the items with factor loadings ≥0.50 to evaluate the internal consistency of the retained components from the PCA. The Cronbach's alphas for components 1, 2, and 3 were 0.88, 0.69, and 0.62, respectively. The item-total statistics showed that alpha levels would not increase with item removal.

Predictive Validity

Component Scores—Component 1 score (OR=1.05, 95% CI=1.01–1.09, p=0.02) and component 3 score (OR=0.87, 95% CI=0.81–0.93, p<0.01) were significant univariate predictors of adherence. The only significant predictor in the multivariate model was component 3 score, representing a "barriers" construct.

Individual CADEES Items—Table 3 shows the 16 items that were significantly (p≤0.05) associated with adherence using univariate logistic regression. The multivariate model containing these items classified cases with 67% accuracy and explained approximately 16% of the variance (Nagelkerke R-Squared=0.163). Table 4 shows that four CADEES items were significant predictors in the multivariate model.

Demographic Variables—Table 1 shows that adherence was significantly associated with a longer duration of diabetes, having insurance, and lower hemoglobin A1c levels. The

multivariate model containing these items classified cases with 66% accuracy and explained approximately 16% of the variance (Nagelkerke *R*-Squared=0.157).

Final Predictive Models—The "component model" classified cases with 69% accuracy and explained approximately 19% of the variance (Nagelkerke *R*-Squared=0.187). Table 4 shows that all four variables in the model were significant predictors. The "individual item model" classified cases with 72% accuracy and explained approximately 24% of the variance (Nagelkerke *R*-Squared=0.235). Two of the four CADEES items ("there are many things that make it hard to get an eye exam every year" and "my insurance covers most of the cost of an eye exam") and two of the demographic variables (years diagnosed and hemoglobin A1c level) were significant predictors in this model (Table 4).

Group Differences

The telemedicine and traditional surveillance group responses differed significantly for only 2 of the 43 CADEES items: (1) those in the traditional surveillance group agreed more strongly that "diabetes can cause severe eye problems" when compared to the telemedicine group (Mean 4.41 vs. 4.19, $p<0.01$); and (2) those in the traditional surveillance group agreed more strongly with the item "I receive a reminder from my eye doctor's office when it is time to schedule an exam" when compared to the telemedicine group (Mean 4.14 vs. 3.87, $p=0.02$). Neither of these items were significant predictors in the multivariate logistic regression analyses.

DISCUSSION

We created the CADEES to measure the demographic, clinical, and health belief variables related to adherence with annual eye exam recommendations in patients with diabetes. Our ultimate goal is to create a tool clinicians can use when interacting with patients and this study provides an important first step. We found that the CADEES has good content and predictive validity, and its organizational structure supported the presence of a "barriers" construct. Given our preliminary findings, we suggest that clinicians address potential barriers and misconceptions related to obtaining annual eye exams in their effort to improve adherence.

The CADEES demonstrated good content validity. Content analysis showed that the survey already included many of the reasons given by participants for nonadherence (i.e., cost, transportation issues, lack of insurance, unaware of importance, and time). Results also revealed a few themes that were not directly measured: procrastination, forgetfulness, and provider availability. While these themes only accounted for 5% of participant responses, future studies should investigate whether they are potential predictors of adherence.

The results of the PCA differed from what we expected given the theoretical framework of the Health Belief Model. Components 1 and 2 included a mixture of items from multiple Health Belief Model constructs, and neither significantly predicted adherence in the multivariate model containing all three component scores. However, component 3 only contained barrier items, supporting the presence of a coherent "barriers" construct. Furthermore, those that were adherent had lower "barrier" scores than those that were

nonadherent. This result is consistent with Janz and Becker's[15] finding that the barriers construct most consistently predicts health-related behavior across various study designs.

The CADEES also showed acceptable predictive validity. The four health belief items significantly associated with adherence in the multivariate model containing only CADEES items can be best categorized as barriers and benefits. These two constructs have received the most attention by those investigating adherence with annual diabetic eye exams.[6, 11–14] Our findings, coupled with the emphasis of previous research, suggest that these two constructs may be the most important when attempting to understand the factors related to obtaining annual eye exams. With regard to demographic variables, our results were consistent with previous research showing that eye exam adherence is associated with a longer duration of diabetes,[7] having insurance coverage,[5, 7] and better blood sugar control.[5, 8] Also similar to earlier studies, we did not observe associations between adherence and gender,[5, 7] race/ethnicity,[7] marital status,[5] or education.[7]

The "individual item" model results suggest that inquiring about perceived barriers may be a key to improving adherence. In some cases, the perceived barrier may be a misconception. In our study, those that agreed more strongly with the statement "my insurance covers most of the cost of an eye exam" were more likely to have obtained an eye exam in the past year. Moreover, this item remained predictive in the final model while insurance status was removed, indicating that one's subjective belief about insurance coverage is more predictive of adherence than the objective measure of insurance status. Patients may not be aware that annual exams to screen for retinopathy are a medical benefit (rather than a vision benefit), and that their exam is likely covered if they have medical insurance.

Our study is not without limitations. Adherence was self-reported. This has the potential to be problematic because people may not remember correctly when their last exam took place, and the subjective nature of self-report introduces the potential for bias. While self-reported adherence may not be ideal, it is practical and used by other researchers examining adherence with vision care guidelines.[5, 7] Adherence could also be ascertained by reviewing medical records; however, this method of data collection also has inherent limitations because medical records can be incomplete or inaccurate.[26] In our study, we did not have direct access to eye care provider records, as participants were recruited from primary care clinics. While we could have reviewed clinic medical records, they are typically updated with eye exam information based on self-report or physician correspondence, which can be problematic as well.[27]

Participants were also taking part in a clinical trial comparing the effectiveness of telemedicine (with a nonmydriatic camera) and traditional surveillance (with eye care providers) for providing diabetic retinopathy screening exams. Involvement in this trial may have influenced the results in three ways. First, although participants received retinopathy screenings with telemedicine, they were asked to continue seeing their eye care provider to obtain a dilated annual eye exam; participants may have mistaken the telemedicine screening for a dilated eye exam, resulting in an overestimation of adherence. However, we think this is unlikely for two reasons: (a) the survey item we used to assess adherence ("Have you ever had an exam when the doctor put drops in your eyes that made your pupils large?") was

written to minimize confusion between the two exam types (the telemedicine exams do not involve dilation); and (b) we compared adherence proportions in this study to our pilot study where participants had no exposure to telemedicine and found that they were similar (58% vs 55%, respectively). Second, our participants might be more adherent than patients with diabetes not enrolled in a clinical trial because of their involvement in the study.[28] Third, our participants may be more knowledgeable about diabetes and the risk of retinopathy when compared to other patients with diabetes because they were exposed to the clinical trial, which may have affected response patterns on the CADEES. For this reason, additional research is needed to validate our findings in a large sample of patients with diabetes who are not participating in a diabetic retinopathy screening study.

Another potential limitation is that the items we created to measure specific Health Belief Model constructs might not measure the intended constructs. This may be due to item content (e.g., what appears to be measuring one construct is measuring another) or item wording (e.g., items may be too agreeable, resulting in the most agreeable items “hanging” together). Future studies should focus on determining whether items can be modified to better measure the constructs of the Health Belief Model. The CADEES would also benefit from research examining its sensitivity to changes following an intervention.

Our ultimate goal is to create a brief survey clinicians can use to tailor their interaction with patients, but additional research is needed before the tool is finalized. Given our current findings, we recommend that patients be “screened” using the significant predictors identified in this study. Adherence was associated with a longer duration of diabetes and better blood sugar control. Therefore, clinicians may want to counsel newly diagnosed patients, as well as those with poor blood sugar control, on the importance of annual eye exams. In addition, clinicians should inquire about perceived barriers to determine whether misconceptions exist (e.g., regarding insurance coverage). How this information is collected, as well as who is responsible for discussing with the patient (i.e., physician, technician, or other staff member) will depend on the flow in each clinic.

In conclusion, clinicians and researchers interested in improving adherence could benefit from a questionnaire that can identify the modifiable patient characteristics and barriers associated with obtaining annual eye exams. The CADEES showed good content and predictive validity. While its structure differed from what we expected given the framework of the Health Belief Model, we found clear support for a “barriers” construct. Future research is needed to determine whether these results are replicable and generalizable in a different group of patients with diabetes.

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Table 1

Descriptives, Univariate and Multivariate Odds Ratios, and 95% Confidence Intervals for Participant Demographic Variables: Compliance with Annual Diabetic Eye Exams Survey (CADEES) 2013

				Univariate♣		Multivariate◆	
	All Participants (n = 316)	Adherent (n = 183*)	Nonadherent (n = 127*)	Odds Ratio (95% Confidence Interval)	P Value	Odds Ratio (95% Confidence Interval)	P Value
Race or ethnicity (%)				0.96 (0.87–1.05)	0.34	--	--
AI/AN only	13.3	17.5	7.9				
Asian only	0.6	0.5	0.8				
Black only	10.1	8.7	12.6				
Hispanic/Latino only	7.6	6.6	7.9				
White only	29.1	25.7	33.9				
Other only	1.0	1.6	0.0				
Multiracial (2 or more)	38.3	39.3	37.0				
Mean age (SD), yrs	55.7 (11.6)	57.7 (11.7)	52.9 (10.8)	1.04 (1.02–1.06)	<0.01	--	--
Years diagnosed, mean (SD)♥	12.8 (8.1)	14.3 (8.2)	10.9 (7.7)	1.06 (1.03–1.09)	<0.01	1.06 (1.01–1.11)	0.02
Hemoglobin A1c, mean (SD)♣	7.7 (2.0)	7.3 (1.5)	8.2 (2.6)	0.80 (0.69–0.94)	<0.01	0.78 (0.66–0.92)	<0.01
Insurance coverage (%)				3.01 (1.84–4.91)	<0.01	2.26 (1.18–4.34)	0.01
Yes	66.1	77	52.8				
No	33.9	23	47.2				
Sex (%)				1.02 (0.65–1.61)	0.92	--	--
Male	45.9	45.9	46.5				
Female	54.1	54.1	53.5				
Marital status (%)				0.95 (0.81–1.11)	0.52	--	--
Single	26.3	24.6	28.3				
Married	31.3	33.9	28.3				
Separated	8.9	8.7	9.4				
Divorced	21.5	23.5	18.9				
Widowed	8.2	8.2	7.9				
Domestic partnership	3.8	1.1	7.1				
Education (%)				1.22 (0.98–1.52)	0.08	--	--

	All Participants (n = 316)	Adherent (n = 183*)	Nonadherent (n = 127*)	Univariate♣		Multivariate◆	
				Odds Ratio (95% Confidence Interval)	P Value	Odds Ratio (95% Confidence Interval)	P Value
None	0.3	0.0	0.8				
Grades 1–6	2.8	2.2	3.1				
Grades 7–12	17.4	15.8	18.9				
Diploma/GED	37.3	35	41.7				
Some college	33.9	37.2	29.1				
College graduate	6	7.7	3.9				
Some postgraduate	0.3	0.5	0.0				
Postgraduate degree	1.9	1.6	2.4				
Mean income (SD), $ ♢	18,882 (22,297)	17,897 (12,906)	20,022 (31,180)	1.00 (1.00–1.00)	0.47	--	--

--Variable not included in multivariate analysis because univariate result was not significant.

*n = 310 (6 participants did not know when their last dilated eye examination took place).

♣Results when predicting adherence using univariate logistic regression.

◆Univariate predictors with P values <0.05 were included in the multivariate model; results of multivariate logistic regression analysis for variables included in the final model after using stepwise backward elimination.

♥Overall, n = 311 (5 participants did not know what type of diabetes they had been diagnosed with); adherence, n = 305 (adherent, n = 180; nonadherent n = 125).

♠Overall, n = 194 (this information was self-reported and 122 people did not know their most recent test result); adherence, n = 191 (adherent, n = 114; nonadherent, n = 77).

♢Overall, n = 258 (58 participants chose not to report their annual household income); adherence, n = 254 (adherent, n = 150; nonadherent, n = 104).

AI = American Indian; AN = Alaska Native; GED = General Educational Development; SD = standard deviation.

Table 2

Principal Components Analysis Factor Loadings for the 3-Component Solution: Compliance with Annual Diabetic Eye Exams Survey 2013

Compliance with Annual Diabetic Eye Exams Survey Item (Health Belief Model Construct)	Component		
	1	2	3
Eye examinations can find many different kinds of eye problems (Be)	**0.79**	−0.90	−0.05
Diabetes can damage the blood vessels in the eye (Se)	**0.75**	−0.08	0.04
I want to get an eye examination every year (O)	**0.74**	0.00	0.11
Diabetes can cause severe eye problems (Se)	**0.73**	−0.14	−0.14
Having a yearly eye examination will help me save the eyesight I have now (Be)	**0.68**	0.22	0.09
I think it is important to have an eye examination every year (O)	**0.66**	−0.02	−0.14
I would benefit from having an eye examination every year (Be)	**0.65**	−0.01	−0.26
My medical provider talks to me about the importance of eye examinations (C)	**0.63**	0.06	−0.15
Diabetic eye disease often causes blindness (Se)	**0.61**	−0.03	0.06
There are things I can do to prevent losing my vision from diabetes (E)	**0.54**	0.19	0.06
Diabetes can result in a loss of visual function (Se)	**0.52**	−0.14	−0.15
I am confident I can keep a scheduled appointment with an eye doctor (E)	**0.52**	0.04	−0.22
I am confident in my ability to make an appointment for an eye examination (E)	**0.50**	−0.02	−0.18
Having an eye examination once yearly can help me prevent losing my sight (Be)	**0.50**	0.07	−0.27
My overall general health is excellent (O)	0.10	**0.78**	0.07
My eyes are healthy (Su)	0.12	**0.68**	0.04
I am confident I can control my blood sugar (E)	0.20	**0.60**	−0.12
Over the past 4 weeks I have felt blue, downhearted, or depressed (O)	0.05	**−0.53**	0.01
I have trouble reading a book or newspaper, even if I use my glasses or contacts (Su)	0.01	**−0.52**	0.22
It is hard for me to travel to an eye doctor (Ba)	−0.08	−0.25	**0.61**
There are many things that make it hard to get an eye examination each year (Ba)	−0.12	−0.10	**0.53**
Having an eye examination is not pleasant (Ba)	−0.10	−0.10	**0.52**
Getting an eye examination every year is not one of my top priorities (Ba)	−0.23	0.14	**0.51**
I cannot afford an eye examination (Ba)	0.13	−0.17	**0.50**

Ba = barriers; Be = benefits; C = cues to action; E = self-efficacy; O = other; Se = severity; Su = susceptibility.

Bold values indicate a factor loading of 0.50 or greater.

Table 3

Descriptives, Univariate and Multivariate Odds Ratios, and 95% Confidence Intervals for the Individual Compliance with Annual Diabetic Eye Exams Survey Items That Significantly Predict Adherence: Compliance with Annual Diabetic Eye Exams Survey 2013

			Univariate		Multivariate*	
Compliance with Annual Diabetic Eye Exams Survey Item (Health Belief Model Construct)	**AdherentGroup, Mean (Standard Deviation)**	**Nonadherent Group, Mean (StandardDeviation)**	**Odds Ratio (95% Confidence Interval)** ♦	**P Value**	**Odds Ratio (95% Confidence Interval)** ♦	**P Value**
I am confident I can keep a scheduled appointment with an eye doctor (E)	4.33 (0.71)	4.09 (0.79)	1.53 (1.12–2.09)	0.01	--	--
I do not want to know if I have an eye disease (Ba)	1.66 (0.86)	1.89 (1.14)	0.80 (0.63–1.00)	0.05	--	--
Diabetes can cause severe eye problems (Se)	4.37 (0.68)	4.18 (0.80)	1.42 (1.04–1.94)	0.03	--	--
I would benefit from having an eye examination every year (Be)	4.45 (0.63)	4.22 (0.80)	1.60 (1.14–2.23)	0.01	--	--
My medical provider talks to me about the importance of eye examinations (C)	4.25 (0.77)	4.06 (0.83)	1.33 (1.00–1.78)	0.05	--	--
It is hard for me to travel to an eye doctor (Ba)	2.09 (1.01)	2.46 (1.14)	0.73 (0.59–0.90)	<0.01	--	--
There are many things that make it hard to get an eye examination each year (Ba)	2.29 (1.00)	2.76 (1.14)	0.66 (0.53–0.82)	<0.01	0.70 (0.54–0.89)	<0.01
I think it is important to have an eye examination every year (O)	4.48 (0.66)	4.29 (0.71)	1.48 (1.06–2.08)	0.02	--	--
Diabetic eye disease can be seen with an eye examination (Be)	3.91 (0.75)	3.68 (0.84)	1.46 (1.09–1.96)	0.01	1.41 (1.00–1.99)	0.05
There are many eye doctors where I live (Ba)	3.81 (1.01)	3.50 (1.07)	1.34 (1.08–1.67)	0.01	--	--
Having a yearly eye examination will help me save the eyesight I have now (Be)	4.35 (0.58)	4.14 (0.72)	1.66 (1.16–2.39)	0.01	--	--
I cannot afford an eye examination (Ba)	2.78 (1.19)	3.24 (1.13)	0.71 (0.58–0.87)	<0.01	--	--
My insurance covers most of the cost of an eye examination (Ba)	3.38 (1.22)	2.78 (1.20)	1.49 (1.21–1.83)	<0.01	1.42 (1.14–1.77)	<0.01
I want to get an eye examination every year (O)	4.43 (0.56)	4.24 (0.80)	1.56 (1.10–2.21)	0.01	--	--
I only seek care when I am having trouble with my vision (C)	2.25 (1.04)	2.51 (1.05)	0.79 (0.63–0.98)	0.03	--	--
Getting an eye examination every year is not one of my top priorities (O)	2.23 (1.08)	2.59 (1.19)	0.76 (0.62–0.93)	0.01	0.75 (0.59–0.96)	0.02

--Variable was not a significant predictor in the final step of multivariate logistic regression model

*Results of multivariate logistic regression analysis for variables included in the final model after using stepwise backward elimination.

♦Odds ratio refers to per-unit increase on the response scale; response given using a 5-point Likert scale anchored with 1 = strongly disagree, 3 = no opinion/don't know, and 5 = strongly agree.

Ba = barriers; Be = benefits; C = cues to action; E = self-efficacy; O = other; Se = severity; Su = susceptibility.

Table 4

Final Step of Logistic Regression Analysis Using Stepwise Backward Elimination for Component Model and Individual Item Model: Compliance with Annual Diabetic Eye Exams Survey 2013

Model	Odds Ratio (95% Confidence Interval)	P Value
Component model		
Years diagnosed with diabetes	1.06 (1.01–1.12)	0.01
Hemoglobin A1c	0.81 (0.68–0.96)	0.01
Insurance coverage (0 ¼ no insurance; 1 ¼ insured)	2.23 (1.15–4.33)	0.02
Component 3 score (barriers)	0.90 (0.82–0.99)	0.03
Individual item model		
Years diagnosed with diabetes	1.08 (1.02–1.14)	0.01
Hemoglobin A1c	0.79 (0.65–0.95)	0.01
Insurance coverage (0 ¼ no insurance; 1 ¼ insured)	--	--
There are many things that make it hard to get an eye examination each year (Ba)	0.60 (0.42–0.84)	<0.01
Diabetic eye disease can be seen with an eye examination (Be)	--	--
My insurance covers most of the cost of an eye examination (Ba)	1.41 (1.06–1.86)	0.02
Getting an eye examination every year is not one of my top priorities (O)	--	--

Ba = barriers; Be = benefits; C = cues to action; E = self-efficacy; O = other; Se = severity; Su = susceptibility.