Real-World Psychosocial Outcomes and Ease of Use Predict Trust in Automated Insulin Delivery Systems

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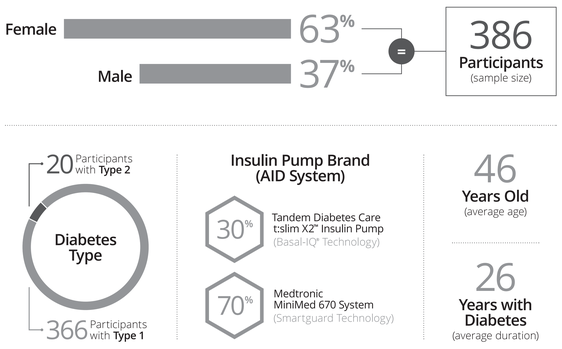
Introduction

Understanding qualities that comprise trust in automated insulin delivery (AID) systems is imperative for successful development of such systems built for long-term use. Previous research has demonstrated that trust in AID is associated with: (a) better glycemic outcomes, (b) decreased self-management burdens, and (c) continued use of therapy.[1-3] The purpose of the current study is to better understand the formation of trust in AID systems by examining the relationship between trust and psychosocial outcomes and AID system usability.

Methods

In December 2018, individuals with diabetes (*N* = 5,037) responded to an online survey administered by dQ&A. Survey questions assessed variables of interest, trust, AID system perceived usability, psychosocial outcomes, basic demographics, and information on method of diabetes management. We analyzed a subgroup of 386 survey participants who reported use on AID systems currently available in the United States.

FIGURE 1: Demographics of Study Participants. All participants used an AID system.



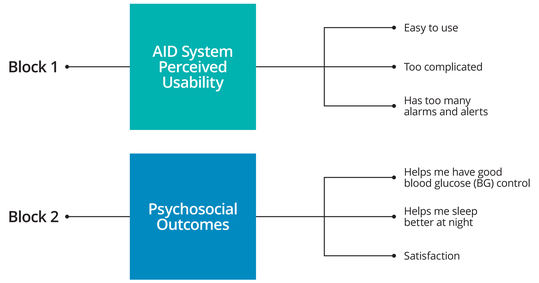
†Tanenbaum ML, Iturralde E, Hanes S J, et al. Trust in hybrid closed loop among people with diabetes: perspectives of experienced system users [published online ahead of print, July 1, 2017]. J Health Psychol. doi:10.1177/1359105317718615. ²Weissberg-Benchell J, Hood K, Laffel L, et al. Toward development of psychosocial measures for automated insulin delivery. J Diabetes Sci Technol. 2016;10(3):799-801. doi:10.1177/1932296815619637. ³Farrington C. Psychosocial impacts of hybrid closed-loop systems in the management of diabetes: a review. Diabet Med. 2018;35(4). 436-449. doi:10.1111/dme.13567.

Results

ANALYSIS AND MODEL BUILDING

A hierarchical multiple regression analysis was used to ascertain the significance of AID system perceived usability and psychosocial predictors of trust in AID systems. Hierarchical regression models were constructed for the outcome variable (trust in AID systems). Based on a priori hypotheses regarding hierarchical relationships between variables of interest and trust, the predictor variables were entered in two blocks (Figure 2).

FIGURE 2: Model Building. Predictor variables in each block.



Assumptions were verified before conducting the analyses; none of the entered variables demonstrated significant deviation from normality or linearity. Collinearity diagnostics were performed and revealed no evidence of significant multicollinearity that might obscure interpretation of the regression analyses (all VIFs <3).

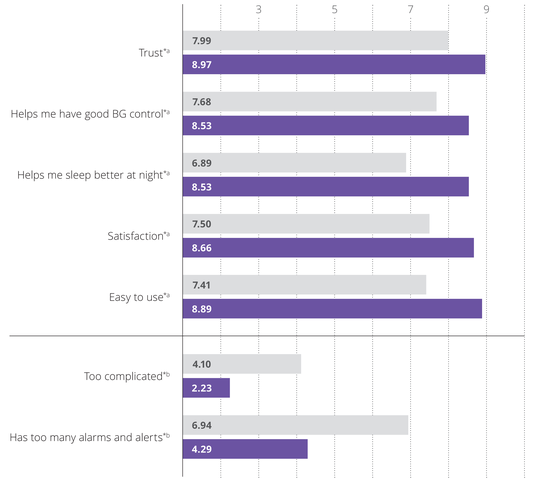
DESCRIPTIVE STATISTICS

Independent t-test analyses were used to determine whether the predictor and/or outcome variables significantly differed based on the brand of AID system (Figure 3).

Results of zero-order correlation analyses were as follows: the outcome variable, trust in AID system, significantly correlated with the predictor variables ($p < .001$): ease of use ($r = 0.65$), too complicated ($r = -0.46$), has too many alarms and alerts ($r = -0.37$), helps me have good BG control ($r = 0.61$), helps me sleep better at night ($r = 0.54$), and satisfaction ($r = 0.73$).

Since the predictor and outcome variables significantly differed based on brand of AID system, a partial correlation was run between predictor and outcome variables controlling for brand of AID system. Results showed no change in the significance or strength of the relationship between predictor and outcome variables. This demonstrates that even though predictors significantly differ by AID system, the relationship between predictors and trust is the same, regardless of the brand of AID system.

FIGURE 3: Differences in Predictor and Outcome Variables by AID System. Mean scores for the MiniMed 670G system with Smartguard technology (■) and the t:slim X2 insulin pump with Basal-IQ technology (■).



*$p < .001$ [a]Higher mean scores are associated with more positive outcomes, while lower mean scores are more negative. [b]Lower mean scores are associated with more positive outcomes, while higher mean scores are more negative.

TABLE 1: Hierarchical Regression Analysis Summary. Variables predicting trust in AID systems.

Model 1 (Block 1) — $R^2 = 0.68$ | Adjusted $R^2 = 0.45$ | $F(3,382) = 106.74$ | $p < .001$

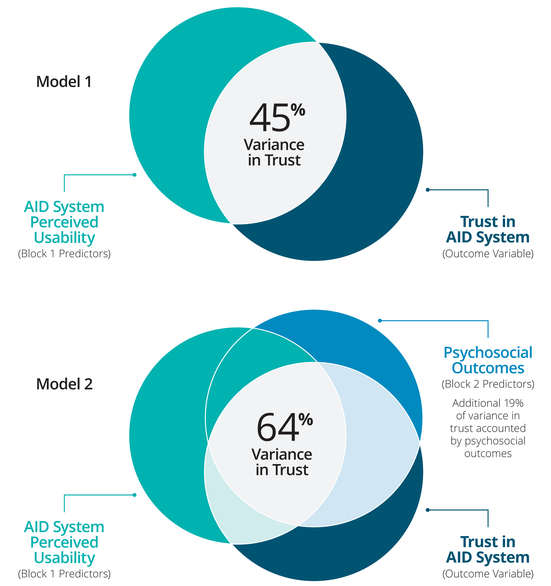
Block 1 Variables	*b* (SE)	β	*t*	sr^2
Easy to use	0.46 (0.04)	0.56*	12.03	.21
Too complicated	-0.06 (0.03)	-0.09	-1.77	.00
Has too many alarms and alerts	-0.08 (0.02)	-0.15*	-3.57	.02

Model 2 (Block 1 and Block 2) — $R^2 = 0.80$ | Adjusted $R^2 = 0.64$ | $F(3,379) = 65.46$ | $p < .001$

Block 1 Variables	*b* (SE)	β	*t*	sr^2
Easy to use	0.12 (0.04)	0.15**	3.07	.01
Too complicated	-0.07 (0.03)	-0.11**	-2.68	.01
Has too many alarms and alerts	-0.01 (0.02)	-0.01	-0.37	.00
Block 2 Variables	***b* (SE)**	**β**	***t***	**sr^2**
Helps me have good BG control	0.43 (0.05)	0.41*	9.32	.08
Helps me sleep better at night	0.19 (0.04)	0.20*	5.06	.02
Satisfaction	0.09 (0.03)	0.14*	3.62	.01

*$p < .001$ **$p < .01$ ***NOTE:*** *Unstandardized regression coefficients (b), standard error (SE), standardized regression coefficients (β) estimates for each predictor variable. t and r^2 values are derived from hierarchical multiple regression analyses performed on these data. sr^2 is the squared semipartial correlation for each predictor with the outcome (removing the other predictors) in the regression model.*

FIGURE 4: Hierachical Regression Results. Venn diagram representation.



HIERARCHICAL REGRESSION ANALYSIS

As summarized in Table 1 and Figure 4, results showed that in Model 1, the AID system perceived usability predictors accounted for 45% of variance in trust. After psychosocial predictors were added in Model 2, variance accounted for was 64%, explaining an additional 19% of unique variance in trust. Specifically, the predictor variables (i.e., easy to use, too complicated, satisfaction, helps me have good BG control, and helps me sleep better at night) all significantly predict trust in AID systems.

Conclusion

Continued attention should be directed toward psychosocial outcomes of AID systems in order to increase likelihood of the sustained use and optimized benefits of AID systems for their users. Future research should examine the longitudinal relationship between trust and AID system perceived usability and psychosocial outcomes.

These findings suggest that both **AID system perceived usability and psychosocial outcomes are** distinctly informative and **instrumental in the development of trust in AID systems.**