A Comparison of Dosing Accuracy: Visually Impaired and Sighted People Using Insulin Pens

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Background: In the U.S. 18% of people with diagnosed diabetes have visual impairment. Insulin pens are widely used by both blind and sighted people. However, major manufacturers include a disclaimer in the instructions warning against use by visually impaired people, without giving a rationale. Published studies neither support nor refute the disclaimer. In 2008, the National Federation of the Blind (NFB) passed a resolution calling for the disclaimer's removal.

Method: The purpose of this study was to compare accuracy of dosing with insulin pens between visually impaired and sighted people. Forty visually impaired and 40 sighted people participated. Inclusion criteria were self-reported diabetes and inability (visually impaired group) or ability (sighted group) to read regular print. The sole exclusion criterion was inability to pass a brief test of decisional capacity. Data gathered about participants included age, gender, length of time since vision loss and since diagnosis of diabetes, and type of diabetes treatment (see Table 1). All participants received standardized instruction for insulin pen use, either in recorded (visually impaired group) of printed (sighted group) format, and delivered 10 systematically varied doses into an injection ball, which was weighed on a precision laboratory balance.

Results: Absolute percent error was calculated for each of the 800 doses delivered. Mean percent error for all doses were compared between blind and

sighted participants using the t-test (see Table 2), and regression analysis was used to check for possible contribution of age, gender, length of time since vision loss and since diagnosis of diabetes, and type of diabetes treatment to the observed variance in the percent error (see Table 3). In addition, assuming that an absolute value dose error of $\leq$ 10% was not clinically significant, the number of potentially significant absolute value dose errors (> 10%) were calculated for both the blind and sighted groups, and compared using Chi-square analysis (see Table 4). No significant correlation with accuracy of insulin dosing was found for any of the analyzed variables: visual status, age, gender, years of having diabetes mellitus (DM) diagnosis, or treatment of DM with or without insulin.

Conclusions: This study raises serious questions about the validity of the disclaimer recommending against use of insulin pens by blind people. Inclusion of people with disabilities in technology research would ensure that new diabetes technology could benefit people with a broad range of abilities.

Table 1 Characteristic of Participants		
	Blind Group	Sighted Group
N	40	40
Age in years (Mean ±SD)	54.90 (±10.16)	
Gender N (%)	Male: 18 (45%) Female: 22 (55%)	Male: 9 (2 2.5%) Female: 31 (77.5%)
Years diagnosed with DM (Mean ±SD)	20.53 (±14.81)	12.3 (±10.96)
Years living with blindness (Mean ±SD)	30.05 (±20.76)	NA
DM treatment: Without insulin N (%)	10 (25%)	24 (60%)
DM treatment: With insulin N (%)	30 (75%)	16 (40%)

Table 2 **Summary of Absolute Value of Percent Errors and T-Test**			
DU=Delivered dose in units; **DG**=Delivered dose in grams; **1.005**=specific gravity of insulin; **APE**=Absolute value of percent error; **IU**=Intended dose in units **DU=DG/1.005** **APE=** $\left\lvert (DU-IU)/IU \right\rvert$ **X 100%**			
	Minimum	Maximum	Mean (±SD)
Blind Group (N=40)	1.30%	18.62%	5.83% (±3.34%)
Sighted Group (N=40)	1.23%	89.15%	6.59% (±13.74%)
T=-.34 *df*=78 *p*=.136			

Table 3 Summary of Multiple Regression Analysis for Variables Predicting Absolute Value of Percent Error (N=80)				
Variable	B	b (SE)	T	P
Age	-.102	-.106	-.920	.361
Gender	2.054	.098	.848	.399
Years diagnosed with DM	.111	.152	1.141	.258
Insulin user	-3.328	-.167	-1.289	.201

Table 4 Summary of Clinically Non-Significant/Potentially Significant Dose Errors		
	Clinically Non-Significant Dose Error ($\leq$ 10%)	Potentially Significant Dose Error (>10%)
Blind Group Doses (N=400)	289	111
Sighted Group Doses (N-400)	271	129
X^2=.952 p=.329		