

## Blue Cross Blue Shield Study and Impact Analysis

### Goldtouch Ergonomic Keyboard vs. Standard Keyboard

#### INTRODUCTION

In conjunction with a large California employer, Goldtouch conducted a five-week study to test the effectiveness and usability of their adjustable keyboard. This study was coordinated by Goldtouch Technologies using bank staff volunteers who had experienced some level of discomfort or injury from extended keyboard use.

All participants in the study had previously been provided with the usual ergonomic equipment (adjustable chairs, keyboard trays and wrist rests), and given instructions on their use. This study then evaluates the additional benefits to be gained from using a keyboard providing a full spectrum of adjustment. This report summarizes the scope of the study and analyzes the results of:

- 1) The specific observation as measured and recorded by the participants and;
- 2) The responses to a survey dealing with each participant’s evaluation and opinion of the Goldtouch Keyboard.

#### RESULTS AND ANALYSIS

##### A. Overall Comfort Level

During the study, participants recorded their level of discomfort to 18 specific body regions. This was completed daily for one week using the standard keyboard and one week using the Goldtouch Keyboard. (The experimental protocol and measurement techniques are described in the Appendix.)

The level of discomfort was measured using a scale of 1 to 6 with 1 being “very slight discomfort” and 6 being “extreme discomfort.” Zero was used to indicate “no discomfort.” Based on the 1620 observations recorded by the nine participants, there were only a total of 7 incidents of discomfort categorized as Severe (Comfort Level 4) and no incidents of Very Severe or Extreme (Comfort Levels 5 and 6).

The data show a substantial overall improvement in comfort level (level 0) as well as a statistically significant decrease in discomfort levels (levels 1 to 6) using the Goldtouch Keyboard. This improvement is over and above any gains that may have been attained by the use of only height adjustments to chairs and desk surfaces.

The following summarizes the discomfort and comfort level observations recorded:

#### DISCOMFORT

Discomfort Level	Standard Keyboard		Goldtouch Keyboard		% Reduction
	# of Incidents	% of Total	# of Incidents	% of Total	Goldtouch vs. Standard
6	0	0%	0	0%	N/A
5	0	0%	0	0%	N/A
4	3	1%	4	2%	N/A
3	95	31%	49	25%	-48%
2	134	43%	82	42%	-39%
1	77	25%	62	31%	-19%
Total	309	100%	197	100%	-22%

One of the most significant results as shown in the above chart is the increasing rate of reduction in discomfort at higher discomfort levels. That is, the greater the degree of discomfort, the greater the increase in comfort level achieved by using the Goldtouch Keyboard.

While there were no observations in this particular sample measured as very severe or higher, these results suggest an even greater reduction (i.e. greater than 48%) in discomfort would be realized for employees experiencing very severe discomfort. It may be speculated that people with greater severity of discomfort may not be able to work at all.

The overall decrease in discomfort levels is 22% (from a total of 309 observations to 197).

## COMFORT

Consistent with the trend of discomfort reduction, was the improvement of comfort levels. This is signified by a zero score for discomfort. There were 613 recordings of comfort with the Goldtouch Keyboard as compared to 501 with a standard keyboard.

0      501    62%   613    76%   +22%

This indicates an increase of 22% in overall comfort level.

## B. Average Severity Analysis

In order to assess the effectiveness of the Goldtouch Keyboard, measurements were recorded and summarized for each of the two weeks of testing. Averages were calculated for each person and body region reported, and these 162 values (9 people by 18 body regions) were categorized by severity as follows:

Category Average	Weekly Discomfort Level
Severe	> 2
Moderate	1-2
Minor	< 1

Based on the above description, the following summarizes the average weekly observations recorded using the standard keyboard and the averages for the same observations using the GT keyboard:

Severity	No. of Weeks Observed	%	Average Discomfort		% Reduction GT/Std.
			Standard	Goldtouch	
Severe	30	19%	2.3	1.2	-20%
Moderate	33	20%	1.5	1.0	-9%
Minor	16	10%	0.5	0.1	-6%
None	83	51%	---	---	N/A
<b>Total</b>	<b>162</b>	<b>100%</b>	<b>.08</b>	<b>.05</b>	<b>-5%</b>

Importantly, as can be seen, approximately one half of the 162 total average observations demonstrated some level of discomfort with keyboard use.

The results displayed above again show a substantial improvement in the reduction in discomfort levels realized after using the Goldtouch Keyboard. As stated earlier, the data shows that those employees experiencing symptoms of Repetitive Stress Injuries due to the use of standard keyboards would experience a significant reduction in discomfort by using the Goldtouch Keyboard.

The proposition of whether or not an injury can be avoided or mitigated by the use of ergonomic intervention has been the focus of many scientific investigations. Recently, NIOSH, The National Research Council and OSHA have all taken a strong position in the affirmative view. Both stressing prevention as the preferred course of action to cure. In this study, there was a demonstrated reduction in discomfort levels indicating that physiological stresses are reduced with the ergonomic adjustment provided by the Goldtouch Keyboard. This result can logically be extrapolated to a lowering of the incidences of injury.

### C. Angle Analysis

At the end of the testing period all the participant's of Goldtouch Keyboard configurations were analyzed. Height from the desktop (non-coplanar, slant) and split (non-linear, splay) measurements were made to ascertain the preferred adjustment angles of the individuals. The following are the results of those measurements in centimeters and degrees:

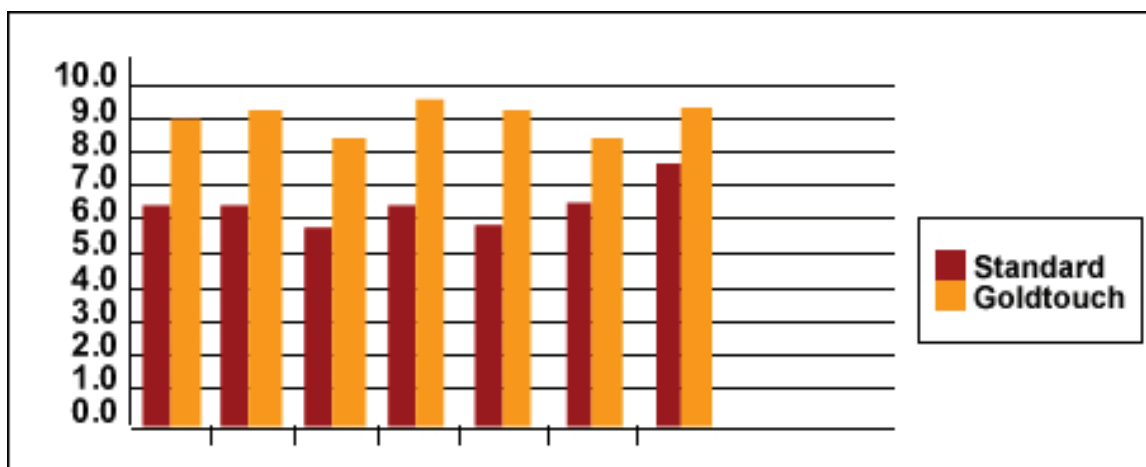
Participant	Height from Desk		Linear Split	
	cm.	degrees	cm.	degrees
1	2.2	6.5	2.2	7.4
2	5.0	14.9	2.9	9.8
3	2.3	6.8	0.4	1.3
4	2.2	6.5	6.4	21.3
5	0.1	0.3	1.8	6.1
6	3.7	10.9	5.1	17.1
7	0.0	0.0	0.0	0.0
8	2.8	8.3	2.3	7.7
9	2.9	8.6	1.9	6.4
10	2.7	8.0	1.8	6.1
11	2.2	6.5	3.1	10.4
12	1.0	2.9	2.3	7.7
<b>Average</b>	2.3	6.7	2.5	8.4
<b>Range</b>	0.0 - 5.0	0.0-14.9°	0.0 - 6.4	0.0-21.3°

Several important observations can be noted:

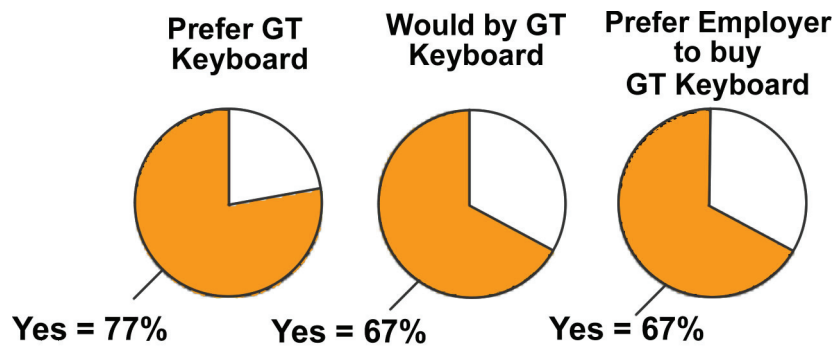
1. The reduction in discomfort was due to the subjects' alteration of the keyboard's adjustable alpha section. The improvements seen were due to this adjustment and not any other variable such as chair and desk height adjustment or ergonomic training as these were previously applied to all the participants by professional ergonomists.
2. All of the participants were instructed to adjust the keyboard to maximize their comfort level. With these instructions, there was only one participant who ended the study with no adjustments to the keyboard. This indicates that the standard keyboard and its flat, linear shape is not appropriate for a large proportion of individuals.
3. The range of angles observed as measured in both centimeters and degrees, indicates that a wide range of adjustable angles is needed in order to reduce the discomfort levels that are associated with a fixed keyboard configuration.

### D. Overall Evaluation of Keyboards - Preferences

Using the assessment questionnaire (see Attachments II and V), all participants used a scale of 1 — 10 (10 being best) to rate various factors relating to the use of a standard keyboard versus the Goldtouch. In each of the seven factors assessed, the Goldtouch Keyboard was rated as better. The following lists the average rating of all participants in the study:



In addition to the evaluation, the assessment survey requested answers to several questions relating to the participant's preferences. Of the total participants answering these questions, more than 2/3 would prefer the Goldtouch Keyboard.



### E. Statistical Test For Level Of Significance

In order to arrive at a conclusion regarding the statistical significance associated with the results of this testing, accepted standard statistical decision theory was utilized. In this process, the tested (null) hypothesis was that there is no difference in discomfort levels between using the standard keyboard and the Goldtouch Keyboard. In testing this hypothesis a 0.2% (.002) level of significance was specified. That is, it was tested whether there was a 99.8% confidence that the assumed hypothesis (i.e. no difference in keyboards) is false and that using the Goldtouch Keyboard does, in fact, result in lower levels of discomfort. The resulting implication being a corresponding reduction in repetitive stress injuries associated with keyboard use.

The most widely used testing technique to determine this confidence is the z-test. By using the z score that results from this test, the significance of the observed difference in discomfort levels between the two sample populations (i.e. using the standard keyboard and using the Goldtouch Keyboard) can be determined. Each sample used 810 observations ({9 participants} X {18 body regions} X {5 days}) of discomfort levels recorded by the participants as follows:

Discomfort Level	# of Observations	
	Standard Keyboard	GT Keyboard
6	0	0
5	0	0
4	3	4
3	95	49
2	134	82
1	77	62
0	501	613
<b>Total</b>	810	810

The following statistics from the two sample populations above have been used to determine the z-score:

Statistic	Keyboard	
	Standard	Goldtouch
Mean	0.793	0.480
Standard Deviation	1.116	0.936
Variance	1.245	0.875

The following table lists the critical values of z at various levels of significance:

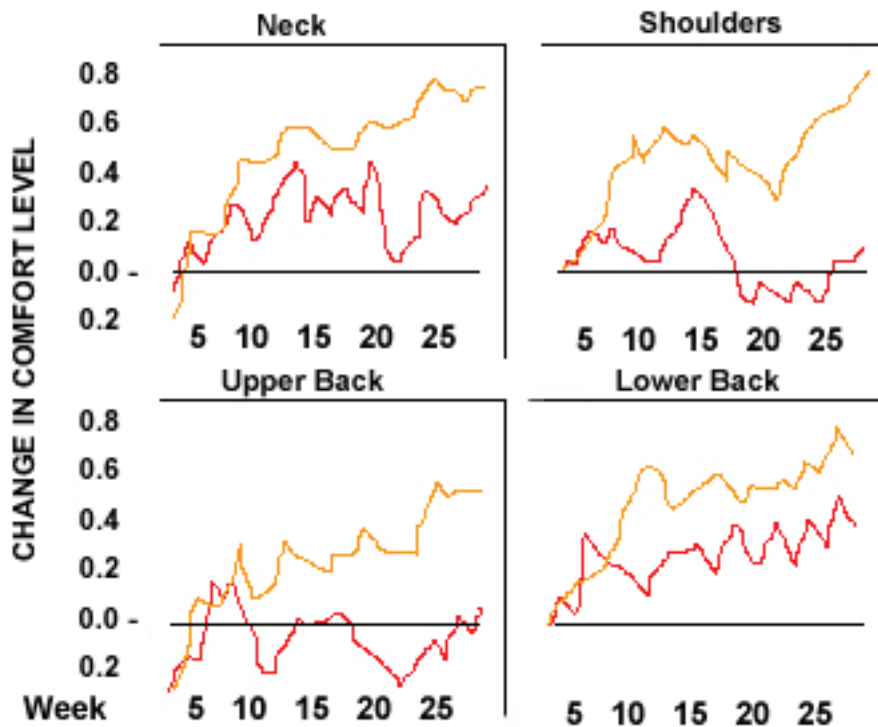
Level of Significance	0.10	0.05	0.01	0.005	0.002
Critical Values of z for z-test	-1.645 and 1.645	-1.96 and 1.96	-2.58 and 2.58	-2.81 and 2.81	-3.08 and 3.08

For this test, the results are significant at a 0.002 level if the z-score lies outside the range of -3.08 to +3.08. The z-score obtained using the above statistics is 6.112. On the basis of this test, at a level of significance of 0.002 (0.2%), the assumed hypothesis that there is no difference between the two keyboards can be rejected.

**Therefore, there is a 99.8% confidence level that the Goldtouch Keyboard reduces the level of discomfort associated with keyboard usage, and that this improvement is in addition to improvements made by standard workplace adjustments.**

### BLUE CROSS BLUE SHIELD CHANGE IN COMFORT RATING THROUGH USE OF THE GOLDTOUCH KEYBOARD

The Goldtouch Keyboard is proven to produce statistically significant improvements in comfort in comparison to a flat, standard keyboard. This occurred overall throughout the study, as well as in specific areas of the body tested in the study.



Above: Changes in comfort level from week = 0 for particular body parts. Significantly different from flat keyboard group.