

Who Responds Best to a Virtual Exercise Coach? Demographics and Patterns of Use as Predictors of Outcome

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Abstract

Recurring patterns of use for a longitudinal automated exercise promotion intervention are identified and correlated with participant demographics and outcomes. We find that health literacy, depressive symptoms, sex, prior exercise knowledge, and body mass index are related to patterns of system use which, in turn, is related to exercise outcomes.

Introduction

The importance of health-related behavior is now widely recognized as a key element in population health, and automated health behavior change interventions have the potential for wide reach and low cost. However, there is evidence suggesting that non-adherence and attrition are even bigger problems for longitudinal interventions that are automated than for interventions involving human counselors. To date there have been few studies investigating the demographics of participants who adhere to prescribed regimens with automated interventions, or whether there is a dose-response relationship between system use and outcomes or whether particular patterns of use are associated with positive health outcomes. Farzanfar conducted one of the few studies we know of, finding that intermittent patterns of use with a telephone-based exercise promotion system were associated with the highest levels of satisfaction and exercise outcomes¹. The primary aim of the present study is to analyze these associations for a recently completed longitudinal clinical trial evaluating an automated exercise coach for geriatrics patients. We hypothesize a dose-response relationship between system use and outcomes, but are also interested in identifying patterns of longitudinal system use predictive of positive outcomes and correlated with patient characteristics. Identifying such relationships will help identify sub-populations for whom automated interventions work especially well, as well as the optimal patterns of system use to promote.

Methods

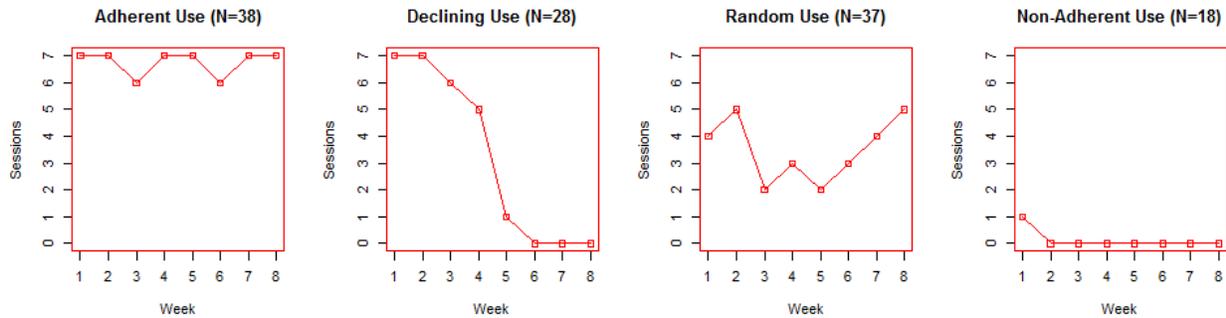
We conducted a secondary analysis of data from a randomized clinical trial designed to evaluate a virtual exercise coach compared to a pedometer-only control group in a population of urban older adult primary care patients². Our focus is on two-month outcomes for the intervention group only; a period during which participants were asked to wear pedometers and conduct daily counseling conversations with the coach on tablet computers provided to them for the study. Participants were recruited from three outpatient clinics at Boston Medical Center and were excluded if they were not fluent in English, had major depression, had moderate-severe cognitive dysfunction, or could not independently consent. Among 121 participants, 66.9% were female, 59.5% were African American, 66.1% were married, and 46.2% had education beyond high school. Participants' ages ranged from 65 to 91 (average 71.7). At the start of the intervention, health, cognitive, sociodemographic, and behavioral measures were collected, including health literacy (using TOFHLA³), depressive symptoms (using PHQ-9⁴), exercise knowledge, and body mass index. Patterns of system use were gleaned from system log files at the end of the intervention. The primary behavioral outcome was changes in average daily steps walked between the first two weeks and the last four weeks of the two-month intervention study, based on pedometer readings.

Results by Number of Sessions

Users held an average of 32.1 (SD=18.1) sessions with the virtual coach (range 1 to 56, out of 60 possible). Among the baseline measures, health literacy, depressive symptoms and exercise knowledge were significantly related to the number of sessions participants conducted. Participants with adequate health literacy conducted 8.6 more sessions than those with inadequate health literacy (34.9 vs. 26.3, $p<.05$). Those with moderate depressive symptoms conducted significantly fewer sessions (only 5.3 total on average) compared to others ($p<.05$). Those with above average exercise knowledge conducted 7.3 more sessions than those with below average exercise knowledge. In addition, there was a significant dose-response relationship between number of sessions and walking outcomes ($r=0.22$, $p<.05$).

Results by Patterns of Use

We plotted all participants' system use on a weekly basis (as in Figure 1), then grouped these based on similarity, resulting in five common patterns. We then conducted a one-way ANOVA with use pattern as the factor and improvement in steps/day outcome as the dependent variable. The results indicated an overall significant difference in outcome by pattern, $F(3,117)=21.9$, $p<.001$. Tukey post hoc tests indicated that two of the patterns were not related to significantly different outcomes and were combined, resulting in the four pattern categories shown in Figure 1: (1) Adherent Use (N=38), utilization is stably continuous, above average every week; (2) Declining Use (N=28), utilization follows a declining trend, often ending in discontinued use; (3) Random Use (N=37), in which use does not follow any of the other patterns; and (4) Non-adherent (N=18), in which use is rare throughout. Participants in the Adherent use group achieved the greatest increase in daily step counts (+894.7) while the Declining use group had the greatest decline in daily step counts (-1047.2) over the two months of the intervention.



Among the baseline measures, sex, $X^2(3)=8.82$, $p<.05$, body mass index, $X^2(6)=13.3$, $p<.05$, and depressive symptoms $X^2(6)=21.7$, $p<.01$ were all significantly related to patterns of use. Among female participants, 35.8% were Adherent, 27.2% were Declining, 22.2% were Random, and 14.8% were Non-adherent. Fully 47.5% of male participants had Random Use. Regarding body mass index: no participants with normal body mass index scores had a pattern of Random Use. Regarding depressive symptoms, while 61.1% of participants with mild depressive symptoms had Adherent Use, 75.1% of those with moderate depressive symptoms had Non-adherent Use.

Discussion and Conclusion

We found evidence for a significant dose-response relationship between automated intervention system use and behavioral outcomes, whether use is measured simply by number of contacts or by longitudinal pattern of interaction. This indicates that maintaining system use and engagement in an automated intervention is indeed a pre-requisite for achieving behavior change objectives. Further, particular patterns of use, such as our Declining pattern, may be diagnostic of a participant who is about to withdraw from the intervention completely, and should be targeted for outreach (e.g., by human counselors or other media) in order to keep them in the intervention.

We also found that individuals with inadequate health literacy or moderate depressive symptoms at baseline demonstrated low levels of system use, while those with above average exercise knowledge demonstrated high levels of system use. Depressive symptoms may affect participants' overall motivation to engage in any kind of exercise program. Thus, some form of depression intervention or referral should be integrated into these systems to ensure adequate participation. Although the intervention was designed with low health literacy individuals in mind, the virtual coach may still have represented a challenge for these participants.

References

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