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Visual Reminders and Patient Compliance of Type 2 Diabetics

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Abstract

Objective: To determine how visual reminders affect patient compliance in Type 2 diabetics following the completion of a disease management program, a pretest-posttest randomized design was used.

Methods: Patients were recruited following enrollment in a diabetes management course. Classes were randomized into the visual reminder group (VG) or control group (CG). The VG selected an object of importance and one seen frequently, reminding themselves to choose healthy behaviors. Baseline and follow-up data included HbA1c, BMI, and exercise time.

Results: For HbA1c, the decrease in the CG was 5.49% (0.56 ± 1.4) while the VG group was 13.3% (1.2 ± 1.6) with no statistical significance between the two groups (p=0.36). From baseline to follow-up, the change in the CG was not statistically significant (p=0.3) while the change in the VG was (p=0.04). For BMI, the CG reduced 0.53% while the mean reduction with the VG group was 1.5%. The difference between the groups was not statistically significant (p=0.61). For exercise time, the CG was increased 18.4% while the mean increase in the VG group was 82.0%. The difference was not statistically significant (p=0.27). The change from baseline for both the CG and VG (p=0.004 and 0.02, respectively).

Conclusion: Though trending positively, this research cannot conclusively confirm the value of a visual reminder in changing patients' health behavior to manage their diabetes. Nonetheless, when considering the clinically significant differences between the CG and VG with greater improvements in all measured variables, implementation of a visual reminder into diabetes management should be considered.

Keywords: Diabetes; Type 2 diabetes; Patient compliance; Disease management; Patient outcomes

Introduction

Type 2 Diabetes Mellitus (T2DM) is a challenge for patients, physicians, and healthcare organizations. Risks patients and physicians deal with include serious complications of nephropathy, retinopathy, and amputation [1]. To successfully manage the disease, patients must control their diet, prick their fingers throughout the day, exercise, and take their medication [2]. From a managed care perspective, 12.3% of adults older than 20 years of age and 25.9% of those over the age of 65 have diabetes, a considerable increase over the past decades [3-5]. Likewise, 14% of healthcare spending goes to treating it, amounting to hundreds of billions of dollars a year, and nearly 95% of diabetes cases are type 2 [6,7]. Lowering glycated hemoglobin (HbA1c) through disease management programs improve patient outcomes and with clinically significant benefits from even small reductions [8-15].

Disease management programs attempt to treat a disease comprehensively. With diabetes, disease management includes patient education, clinician guidelines, regular laboratory tests, referrals to podiatrists and ophthalmologists as needed, provision of glucose-testing supplies, and so forth [16]. Providers benefit from disease management programs because of the assistance from other members of the healthcare delivery system and improved patient outcomes [13]. Managed care organizations benefit not only from the improved

patient outcomes, but also from reduced patient costs. Providers may be ordering more laboratory testing and patients may be seeing more specialists, but cost savings result from reducing the long-term complications.

Current research on disease management has been focusing on novel techniques of administering programs such as delivery methods and provider training. The overall success of disease management programs has led researchers to inquire if better results can be reached with various administrations. However, little research has focused on methods for daily reinforcement of the material learned in disease management programs. The data have demonstrated that disease management programs can be effective, but there is still room for improvement; patients, providers, and health plans alike need to identify other tools to further improve patient outcomes [9-15].

There is limited research on the use of visual reminders to change health behavior. However, this technique has been evaluated in areas such as sunscreen use, smoking cessation, and dieting [17-19]. The literature is lacking in terms of evaluating this technique in the application of a disease management program or with T2DM as the focus. The goal of this study was to determine if the use of a visual reminder can improve patient compliance in Type 2 diabetics following the completion of a disease management program.

Methods

Study design and analysis

The Wellness Center (TWC) is an out-patient clinic of San Joaquin Community Hospital in Bakersfield, CA, with patients referred from community physicians. The diabetes educational series is one routinely administered at this site by Certified Diabetes Educators, Registered Nurses, and Registered Dieticians. This consists of four, two-hour courses on an introduction to diabetes, medications, meal planning, and exercise.

Subjects were selected from those who had enrolled in the series at TWC. Classes as a whole, not as individual subjects, were randomly assigned to the control group (CG) or visual reminder group (VG) to test the hypothesis that a visual reminder would encourage behavior changes following completion of the series as measured by HbA1c, body mass index (BMI), and exercise time. Inclusion criteria consisted of enrollment and completion of the educational series, a diagnosis of T2DM, and age of 18 or older. Exclusion criteria included a baseline HbA1c level of less than 6.5% or a diagnosis of any form of diabetes other than T2DM. Pregnant women were excluded.

The expected sample size necessary, using the independent samples t-test, to conduct a valid statistical analysis was 14, seven in each group. This calculation was done using the statistical software G*Power [20]. This was confirmed with using a standard t-test sample size formula [21]. A two-tailed analysis was selected. An alpha of 0.05 and beta of 0.2 were used to make this study as robust as possible from a statistical perspective. An effect size of 1.67 was calculated for a change in HbA1c level in the intervention group of 0.5 higher than the CG with a standard deviation of 0.3. A reduction in HbA1c of 0.5 would be clinically meaningful [**8**]. The choice of 0.3 for the standard deviation of the mean difference was a logical guess, derived from the wide range of initial and follow-up values in the literature on diabetes management [9-15]. TWC experiences an average drop-out rate of patients who do not complete the entire four courses of 10-20% (K. Wiggins, personal communication, June 14, 2010). It was expected to lose a comparable amount after that course series was completed who would not return for their follow-up visit. Therefore, a minimum of ten subjects per group, for a total of 20, were recruited.

Baseline data, measured during the pretest, included HbA1c, BMI, and minutes of exercise per week. After randomization, on the first day of the class series, the VG group was read the motivational statement:

You will learn in this class that controlling your diabetes with regular exercise, a proper diet, and use of physician-prescribed medication is very important. How well you control your diabetes will have a direct impact on long-term complications you experience because of it.

This research is designed to identify ways to help you control your diabetes. In order to do this, you need to select a visual reminder you see on a daily basis. This should be something that evokes positive emotions and feelings for you; you want this visual reminder to be a source of encouragement to you. Next week, you will be asked to share this visual reminder and affirm the statement: "When I look at (my visual reminder), I will remember to make good behavior choices that will help me control my diabetes."

The VG was also asked to select an object they see daily that was of importance to them to serve as a reminder of what they learned in the course. The following class session, each subject identified their selected visual reminder and made a commitment to changing health related behaviors that would improve their diabetes management. Subjects then continued on with the course as usual. Follow-up data was collected 3 months following completion of the educational series; the VG was also asked at the follow-up the frequency they saw their visual reminder (Frequently: three or more times each day; Often: three or more times, most days; Sometimes: one or two times, most day; Rarely: less than once per day; or Never) and perceived influence it had on altering their behaviors (Significant: it reminded me to make healthy choices and I did so all or most of the time; Great: it reminded me to make healthy choices, and I did so most of the time; Some: it reminded me to make healthy choices and I did so some of the time; Little: it reminded me to make healthy choices, but I did not do so; or None: it did not remind me to make healthy choices).

Statistical significance between the two groups of the HbA1c, BMI, and exercise time data was analyzed with an independent samples t-test. To determine a significant difference from baseline to follow-up within each group, a paired sample t-test was performed.

Instrumentation validity and reliability

Measurement of HbA1c levels was done with the DCA 2000+ Analyzer from Bayer which has shown to have comparable results to standard laboratory methods [22].

Ethics review

The methods and ethics of this study were evaluated by the Institutional Review Board at The Rutgers School of Health Related Professions.

Results

Subject enrollment

The response rate from TWC patients willing to participate was generally high at 44%. The majority of those who declined participation were male, 68% of those asked, or African-American, 71% of those asked. During the enrollment period, 27 subjects volunteered and had their HbA1c analyzed. Four subjects were excluded because their HbA1c was too low to meet the study inclusion criteria. One subject's analysis was unsuccessful and refused a second finger prick. Twenty-two subjects continued with the study and began the education series at TWC. Three subjects did not complete the course series and, despite given the opportunity, never returned to complete the courses missed. Two subjects did not return for their follow-up analysis. Final subject count was 17: 9 in the VG and 8 in the CG.

Baseline characteristics

Table 1 shows the baseline characteristics of the two groups, which did not vary significantly. The most noted differences were with sex and diagnosis time. The VG contained markedly more men and fewer women than the CG. Similarly, the CG had a noticeably longer time since their initial diagnosis than the VG. The CG and VG were both primarily made up of Caucasian subjects (75% and 66.7%, respectively) but also included Hispanic (25% and 22.2%) as well as African American (0% and 11.1%).

| Characteristic	Group		P Value
	CG	VG	
Mean Age	63 ± 11.5	54.3 ± 10.5	0.14
Male%	37.5	55.6	
Mean Diagnosis Time (years)	8.3 ± 9.0	3.9 ± 5.9	0.25
Mean HbA1c	7.8 ± 1.4	8.3 ± 1.5	0.49
Mean BMI	34.9 ± 5.3	36.4 ± 3.9	0.51
Mean Exercise Time (mins/week)	88.1 ± 73.3	61.7 ± 57.3	0.51

Table 1: Subjects baseline characteristics.

Visual reminders

A narrow range of visual reminders was selected, mostly either photographs of family members or actual individuals of meaning to the subjects. Further, reasons for selecting a given reminder were generally from a motivational aspect for being healthy for loved ones. A frequency of seeing their visual reminder of "Sometimes," "Often," or "Frequently" was reported by 77.8% of the subjects, with 44.4% reporting "Often" or "Frequently." An impact on one's changing one's behavior of "Some," "Great," or "Significant" was reported by 77.8% of the subjects, with 55.6% reporting "Great" or "Significant."

Blood glucose

Both groups had a reduction in HbA1c. The mean reduction with the CG was 5.49% (0.56 ± 1.4) while the VG group was 13.3% (1.2 ± 1.6; Figure 1). There was no statistical significance between the two groups (p=0.36). A reduction was observed in 62.5% of the subjects in the CG and 77.8% in the VG group. Of those subjects, 50% and 55.6%, respectively, had a clinically significant reduction [8]. Further, 12.5% and 55.6% lowered their HbA1c enough to meet the goal established by the American Diabetes Association (ADA) of 7.0% [23].
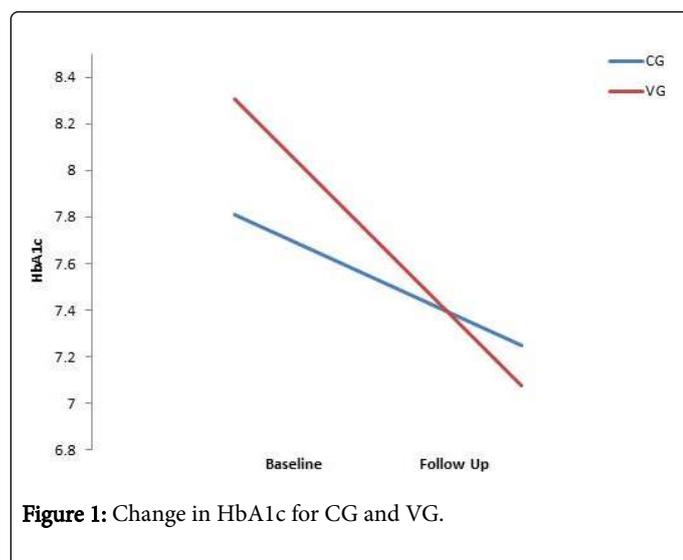
Figure 1: Change in HbA1c for CG and VG.

Though the results were not statistically significant between the two groups, a paired sample t-test revealed a non-statistically significant change in the CG (p=0.3) while the change in the VG was

statistically significant (p=0.04). However, the change for all subjects as a whole was 9.6% (0.92 ± 1.5) and was a statistically significant change (p=0.02).

BMI

Both groups experienced a reduction in BMI. The CG reduced their BMI by a mean of 0.53% (0.19) while the mean reduction with the VG group was 1.5% (0.54). The difference between the groups was not statistically significant (p=0.61). A paired sample t-test revealed neither group had a reduction that was statistically significant at follow-up versus baseline (p=0.78 and 0.28, respectively).

Exercise time

There was an increase in weekly exercise time in both groups. The mean increase with the CG was 18.4% (6.3 minutes per week) while the mean increase in the VG group was 82.0%, (50.6 minutes per week). The difference was not statistically significant (p=0.27). The paired samples t-test revealed a statistically significant change from baseline for both the CG and VG (p=0.004 and 0.02, respectively). Likewise, there was a statistically significant change for all subjects as a whole (p=0.04).

Discussion

HbA1c

The hypothesis was not conclusively supported by the data gathered in this study. These results conflict with data from other studies using a visual reminder. Previous research has shown that both positively and negatively phrased visual messages can affect health related behaviors and attitudes, specifically related to smoking [19]. In their work, subjects' attitudes toward smoking as well as cigarette consumption improved with either phrased message, but more so with positively worded messages. This is similar, compared to the current research, to the motivational statement subjects read and affirmed. Though the effects on a printed visual reminder had impacts on nonsmoker's and smoker's attitudes, the same was not seen with T2DM patients.

Some of the inconsistencies could be explained by the notable difference in the two groups of percentage of male participants. The CG was made up of 37.5% male subjects while the VG group had 55.6% male. Men are less likely to wash their hands following restroom use even with a visual reminder to do so [24]. In fact, in this specific example, men's hand washing behavior did not differ in the presence or absence of a visual reminder. Since the VG group had a markedly higher percentage of men than the CG, it is possible this affected the results.

Another explanation for the difference could be the type of visual reminder, frequency of exposure to the reminder, and length of time between initial exposure and measurement of behavior change. In the other studies, the visual reminder was generally some variation of a message reinforcing the behavior change goal [17,19,24]. Conversely, this research asked subjects to pick a meaningful item to them as a positive reminder and had frequent exposure, possibly reducing the effectiveness of the message behind the reminder. Additionally, all of the studies, with the exception of Schneider et al. [19], did not determine a behavior change beyond the immediate period of time after initial exposure. However, other research has examined the efficacy of frequently viewed reminders. Fox [25] reported the impact

on fruit and vegetable sales at grocery stores near billboards with pictures of a fruit or vegetable and the health message "eat five a day for better health." Stores nearest the billboard had an increase in sales of 4% to 20% versus the same time period the previous year. Though there was no measurement on the frequency of which consumers viewed the billboard, the visual reminder in Fox et al. report is closer to what was evaluated in this work in regards to frequency, suggesting that the impact of the message does not necessarily deteriorate over time. Nonetheless, the results were not consistent.

Both groups had clinically significant reductions in HbA1c, greater than 0.5, and the VG group's reduction was more than double what was observed from the CG [8]. Additionally, more subjects in the VG group had a clinically significant reduction and far more met the ADA goal [23]. Subjects also reported a fairly high amount of impact from viewing their visual reminder. The hypothesis was supported to a degree by the marked difference between the two groups, despite not reaching statistical significance.

The lack of a statistical significance and inconsistencies with previous research can largely be explained by the small sample size and the variability of HbA1c between subjects. Though the sample size was larger than needed and the difference between the two groups was greater than expected, the variability was much greater than anticipated. Repeating the sample size calculation, again using the statistical software G*Power, keeping all variables the same as used prior to commencing the research, but replacing the effect size of 1.67 with 0.46 based upon the actual variability observed, the required sample size increases over ten-fold to 152 [20].

Secondary variables

Both the CG and VG had a reduction in BMI throughout the duration of the study, though the VG's percentage of BMI decrease was nearly three-fold the CG's. Though the difference between the two was not statistically significant and the change from baseline to follow-up was also not, the clinical significance of a nearly three-fold difference in BMI change supports the role of a visual reminder in patients changing behaviors that lead to weight loss. Any issues with the sample size aside, there was not enough of a time span from the baseline to follow-up measurements. An observational study, grouping subjects based on their intention to lose weight or not showed an increase in BMI over one year [26]. Statistically significant reductions in BMI have been observed in a period of just two months, but when the intervention being studied specifically focused on weight loss [27]. The data indicate a trend supporting the use of a visual reminder that may have been statistically significant with a longer period of time.

Given the large changes in minutes per week of exercise (18.4% for the CG & 82.0% for the VG) and the lack of statistical significance between the two, this variable perhaps suffered most from the small sample size. This is further supported by the statistical significance within each group and the totality of subjects from baseline to follow-up. Likewise, the markedly higher increase with the VG is consistent with prior research changing health related behaviors with a visual reminder [17,19].

Limitations and further research

The most significant weakness of this study is the small sample size. Due to the small sample and the high variability that was observed, it is not possible to reach a conclusive decision on the value of a visual reminder in improving T2DM patients' compliance. However, this is easily resolved through additional research with larger subject samples.

Less significant weaknesses include the omission of other important variables to diabetes management: blood pressure, medication adherence, regular check-ups with various specialists, and the like. This was beyond the scope of this study and was not included because the HbA1c measurement was considered representative of overall patient compliance and reflective of a subject's risk level [8]. Additional research could be carried out evaluating the impact of a visual reminder on these specific variables. Conversely, strength of this study was evaluating a practical and easy-to-implement intervention. In an environment of rising healthcare costs, simple and low cost methods to improve patient outcomes are needed. Using a visual reminder, such as was evaluated in this research, is also easily applicable patients and no special training, education, or investment is required.

Conclusion

This research cannot conclusively confirm the value of a visual reminder in changing patients' health behavior to manage their diabetes. Though the data is trending toward a beneficial role, the sample size was not sufficient enough to definitively draw such a conclusion. Nonetheless, when considering the clinically significant differences between the CG and VG with greater improvements in all measured variables, implementation of a visual reminder into diabetes management should be considered. This is certainly true when considering the reported influence and how simple and inexpensive it would be to do so.

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