Behavioral Factors Associated with Glycemic Control in Diabetic Veterans

Capstone Manuscript

Laura Mastella

University of Maryland School of Nursing

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ABSTRACT—

Background: Veterans have a higher prevalence of Type 2 diabetes than the general population, and experience more problems with glycemic control, placing them at greater risk for complications. The primary purpose of this study was to examine two self-management behaviors in a sample of diabetic veterans, and to evaluate indicators of adherence to diabetes treatment regimes and glycemic control. Our hypothesis was that veterans who maintained logs and refilled medications on time would have better glycemic control than those who did not perform these specific behaviors.

Methods: We examined a convenience sample of 261 adult Type 2 diabetic veterans seen in Vet Fitness Clinic at VAMHCS from 2006-2009. All subjects were treated with prescribed medications as part of their routine diabetes care. Based on related studies, we identified Self-Monitoring of Blood Glucose (SMBG) and medication refill procurement as behavioral predictors of Hemoglobin A_{1c} outcomes.

Results: Using a dependent samples t test, improvements in HbA_{1c} from first to final contact in clinic were evaluated. As an expected clinical outcome related to treatment, statistically significant improvements were seen in HgA_{1c} from baseline to discharge (t 16.5, p=.000), however, 60% of the veterans were able to reach goal values (baseline mean 9.10%, ±2.10, discharge mean 7.40%, SD ±1.21). The strongest behavioral predictor of glycemic control was medication refill (t= 3.11, p=.002). Maintenance of SMBG logs did not produce significant improvements in HbA_{1c} (t= 0.33, p=.74).

Conclusions: Despite timely medication refills, 40% of the subjects did not attain optimal HgA_{1c} values. Actual adherence to medications cannot be established using refills as an indicator. While SMBG logs have been associated with improvements in some studies, we did not find the same relationship here. We believe that other unmeasured self-management behaviors may be vitally important in optimizing glycemic control in veterans. For example, health literacy, which is known to be lower in veterans, warrants further examination, as veterans need working knowledge in order to self- manage all aspects of their disease.

Introduction

Individuals with type 2 diabetes face multiple challenges in establishing health behaviors that optimize glycemic control and reduce the incidence of diabetes-related complications. These challenges are especially important in the veteran population that has a higher prevalence of diabetes and poorer control than the general population (Nowicki, Billington et al. 2003; Miller et al. 2004; Nelson et al. 2007). In 2006, at the VA Maryland Health Care System (VAMHCS), the percent of diabetic veterans that had reached a glycosolated A_{1c} (HbA_{1c}) goal of less than 9% was only 12%. (VAMHCS Center for Performance data, FY06). Despite recent improvements in treatment options to improve glucose control, fewer than 15% of diabetic adults in the general population reach glucose goals as defined by the American Diabetes Association (ADA) (Nam, Chesla, Stotts, Kroon, & Janson, 2011).

Studies have identified the importance of self-management behaviors in diabetes care (Reiber, Koepsell, Maynard, Haas, and Boyko 2004; Nelson, McFarland, and Relber 2007). However, many people find it difficult to self manage their diabetes (Daly et al., 2009; Chebowy, Hood, and LaJoie 2010). Specific interventions are needed to optimize self-management behaviors for glycemic control in veterans.

The use of medications for the treatment of diabetes is clearly linked to improved glycemic control and improved diabetic outcomes. However, medication non-adherence according to Cramer, (2004) is common among type 2 diabetics and leads to increased morbidity and mortality. Therefore, interventions that improve medication taking behaviors are crucial to include in plans of care for all diabetics.

One method designed to ensure the effectiveness of medications and other lifestyle behaviors is the self monitoring of blood glucose (SMBG). According to the American Diabetes

Association (ADA), SMBG is considered the cornerstone of self-management (Harris, 2001). The SMBG is a useful tool that can improve compliance with treatment recommendations including medications, diet and exercise resulting in overall improvements in glycemic control.

Medication Adherence

Optimization of pharmacotherapies and adherence to prescribed regimens has been examined in veterans through the use of pharmacy refill data as a predictor of glycemic control. According to Nelson et al (2007), medication non-adherence was found to be the strongest predictor of poor glycemic control (OR = 1.42, 95% CI = 1.31, 1.55). Multiple methods have been utilized to assess medication adherence including medication diary, pill counts, electronic medication caps and pharmacy refill data. In our study, we evaluated timely refills of prescribed medications via electronic medical records to indicate that Veterans obtained medications according to plan.

Self Monitoring of Blood Glucose

One study conducted by Levine et al. (2009), examined the use of self-monitoring of blood glucose (SMBG) in a nonveteran population, and found that those who did not maintain a blood glucose log were more likely to have poor control of their diabetes. SMBG testing is a highly technical task that is recommended to be performed at least daily in type 2 diabetes. However, given that most type 2 diabetics are treated with insulin therapy, testing can be as often as four times a day. The interpretation of fasting and post-prandial SMBG requires that the individual comprehend the rationale for testing, interpret the results and then act on the results obtained (Mbaezue, Mayberry, Gazmararian, Quarshie, Ivonye, & Heisler, 2010). Without the above knowledge, the tracking of SMBG in self-management affects its usefulness. Providers of health care must find ways to identify, plan, and assist their patients to adopt health-behaviors

that improve their health and prevent life-threatening diabetes-related complications (Chlebowy and Garvin, 2006). There is limited population-based information regarding behavioral factors affecting diabetes and glycemic control in veterans.

Purpose Statement

The primary purpose of this study was to examine two self-management behaviors (medication refill records and SMBG logs) among Type 2 diabetic veterans seen in Vet Fitness, and to evaluate factors that may have an effect on adherence to diabetes treatment regimes and achieving HgA_{1c} goals. We hypothesized that individuals who keep a glucose monitoring log and refill prescriptions according to prescribed schedule will have better glycemic control than those who do not perform these behaviors. We also hypothesized that older individuals, those of racial minority groups, and those with multiple co-morbidities would be less likely to achieve glycemic control targets than other veterans with Type 2 diabetes.

Methods

The Vet Fitness clinic is a nurse practitioner operated clinic initially created to address VA system-wide performance on established diabetic measures including the goal of HbA_{1c} less than 9 percent in veterans with diabetes. Strategies used by practitioners in the clinic included regular SMBG monitoring, addition of regular activity (walking), and encouraging changes in dietary intake that are more "diabetic friendly". Pharmacological interventions included: initiation of insulin or changes in doses or optimization of current oral antihypoglycemic agents to achieve euglycemia.

Study Design

Approval from the Institutional Review Board (IRB) at University of Maryland Baltimore and the Maryland VA Research and Development Office was obtained. We examined

a convenience sample of adult Type 2 diabetic veterans who were seen in Vet Fitness Clinic at VAMHCS from 2006-2009. All subjects were treated with prescribed medications as part of their routine diabetes care. Based on related studies (Levine, 2009; Nelson, 2007; Mbaezue, Mayberry, Gazmararian, Quarshie, Ivonye, & Heisler, 2010), we identified Self-Monitoring of Blood Glucose (SMBG) and medication refill procurement as behavioral factors associated with HbA_{1c} outcomes.

Within the clinic setting, veterans were seen for intensive optimization of glycemic control with visits occurring every one to two weeks. The SMBG logs and medication refills were included in ongoing assessments to gain an overall picture of self-management behaviors associated with glycemic control. Once SMBG values indicated improved control, follow-up of HbA_{1c} was performed to validate glycemic control. All data were entered into the *Statistical Package for the Social Sciences (SPSS) version 18* and used for data analysis.

Sample selection

A convenience sample of 554 diabetic veterans seen in Vet Fitness Clinic at VAMHCS from 2006-2009 was utilized. All subjects were adults greater than 18 years of age with a diagnosis of type 2 diabetes who received diabetes related care through Vet Fitness. Only those with pre (prior to or at first clinic visit) and post (upon discharge from clinic) HbA_{1c} data were included in this analysis. Veterans were excluded if they were only seen for one visit, or were lost to follow-up. This left a final sample size of 261. *Measurement Methods*

Self-Monitoring Blood Glucose Log

Veterans received instructions regarding the frequency and timing of testing (whether fasting, before meals or two hours after eating a meal), and were provided with a tool to record blood glucose values The medical record of each subject was reviewed by an advanced practice

nurse to determine maintenance of a self monitoring blood glucose log (SMBG). This was measured as whether the individual did or did not maintain a log and present it along with glucometer for verification at each clinic encounter.

Pharmacy Refill Data

Medication adherence was measured through the use of pharmacy refill data obtained from the computerized patient record system (CPRS) and categorized as whether or not the veteran requested and received a refill of antidiabetic medications including insulin and oral antihyperglycemic agents (OAA) during the course of management within the Vet Fitness clinic setting.

Outcomes

Glycemic Control

Measurement of HbA_{1c} was performed prior to the first clinic appointment and upon discharge from the clinic. Routine use of HbA_{1c} test in all patients with diabetes is recommended to document the degree of ongoing glycemic control as part of the initial assessment and for continuing monitoring and management.

Data Analysis

Demographic and Clinical Data Collection

Because we wanted to examine sample characteristics that might be related to self-management behaviors and diabetic outcomes, we collected information about age, sex, racial ethnicity, service era, service connected related disability, income, number of visits, pharmacy refill data, maintenance of a glucose log and HbA_{1c}. These data were downloaded from the computerized patient record system (CPRS) and entered into a relational database on a VA server behind the VA firewall. Initial exploratory data analysis was performed to characterize the

population, to identify extreme values (i.e. outliers) and to visualize data distributions. Descriptive statistics were utilized to examine the demographic and clinical characteristics

As this study was a retrospective review based on records, individual scores on the measures were examined at two time points: the initial visit and at discharge from the clinic. Dependent paired *t* - test was conducted to assess the within subject scores from baseline to post. Two-tailed $p < 0.05$ was considered significant. Linear regression was utilized to examine the differences in behaviors (SBGM, pharmacy refill). ANOVA was utilized to compare the within group differences of HbA_{1c} (independent variable) and race, and age. Any veteran with missing data was removed from the final data set.

Results

The mean age of the sample was 64.5, ± 10.41, with 34.5% Caucasian, 64.4% African American and 1.1% Hispanic. (Table 1). The majority, (96.9%) were male, with 49.4% serving in the Vietnam era. Forty four percent of the sample earned $15,000.00 or less per year. The average number of Vet Fitness clinic visits was 5.14. A total of 33% of the subjects maintained a SMBG log, and 66% received medication refills as prescribed (Table 2.). Prior to treatment 23.7% of the sample had $HbA_{1c} \leq 7.5\%$, compared with 59.6% upon discharge from the clinic, reflecting a significant improvement over the course of clinic contact ($p= 0.000$).

Dependent paired t-test was conducted to determine improvements in HbA_{1c} from first to final clinic visit. Statistically significant improvements were seen from baseline (HbA_{1c} M 9.1% ±2.1), to discharge (HbA_{1c} M 7.4% ± 1.2), with a mean score of 1.7, SD 1.6, SEM 0.10, (t 16.5, p=.000 two tailed), 95% CI: -1.5 – 1.9.

Logistic regression analysis (Table 3.) was performed to predict improvement in HbA_{1c}. The model contained HbA_{1c} post as a continuous variable, and medication refill and SMBG log

as dichotomous variables (1 =yes, 2=no). The strongest predictor of improvements in glycemic control was medication refills, and was statistically significant, F (2, 257) = 6.16, p .002 when not adjusted for HbA_{1c} pre. The use of regular medication refills accounted for a one half percent (0.5%) decrease in HbA_{1c}.

Logistic regression was performed to assess the impact that medication refill, and SMBG had on HbA_{1c}. The model contained five independent variables (log, refill, age, sex, and race). This model allowed for the control of age, sex and race. The full model containing all predictors was (6, N=261) = 2.32, p = .033, indicating that the model was able to distinguish between participants who maintained their SMBG log and received medication refills.

Discussion

This study evaluated two self-management behaviors that have been shown in previous studies to influence glycemic control. Our results showed that Veterans who received medication refills during treatment through Vet Fitness had improved glycemic control. However, despite regular medication refills only 60% of the subjects were able to reach established goals for glycemia ($HbA_{1c} \leq 7.5\%$). These finding suggest that despite the ordering and procurement of refills on prescribed medications, other factors may affect diabetic control. For example, it is unknown whether the individual is actually taking the medication at the prescribed dose and time. Additionally, doses of medications may have been inadequate to achieve euglycemia, which is of great concern when everyday adherence to dietary and activity recommendations is not known.

Additionally, the regular use of SMBG in this study was not associated with improvements in glycemic control as it was originally hypothesized. Even though 33% of this group of individuals monitored blood sugar as prescribed and presented the results at each visit

that alone was not enough to reach glycemic goals. These results affirm the importance of determining the effectiveness of medications, and also pinpointing lifestyle changes including diet and exercise. This finding also may suggest that veterans require more guidance in interpreting testing results and adjusting diabetes management activities. Despite obtaining medications and monitoring of blood sugars, Veterans in this sample still had difficulty achieving glycemic goals, which suggests other factors warrant investigation.

One such area that may be missing but was not assessed in this group of veterans was health literacy. Health literacy has been defined as proficiency needed to understand and act on health information (Petite et al. 2008). It has been reported that as many as 62% of VA patients have low health literacy (Petite et al. 2008). Low health literacy, may limit the veterans' ability to understand information provided to them and act on results obtained and should be further explored in this population.

Clinical implications

Advanced practice nurses providing care to diabetic veterans are in an ideal position to assess the patients' understanding of the disease, barriers to care, and readiness to change behaviors. These factors are important in determining ways to deliver health care in a manner that is appropriate to the individuals' understanding. Individually tailored and mutually agreed upon goals engage the patient in all aspects of care. Advanced practice nurses are also in a unique position to reinforce self-management behaviors at each visit and to address health literacy through increased education.

Limitations

There are several limitations in this study. First, this study is a retrospective review, with convenience sampling that utilized pre and post data only. However, the characteristics of the sample population are similar to the larger veteran population. Veterans were seen for short duration (average 6 visits), and no long term data regarding glycemic control is available. Moreover, as this sample is an all veteran population, its generalizability to other populations is limited.

Future directions

The results of this study raise important questions regarding key factors that are needed to enhance the self-management of diabetes in the veteran population. Medication refills and SMBG alone do not directly translate into glycemic control. Successful self-management requires adequate knowledge to carry out the necessary behaviors. Further studies are needed in veterans to assess factors such as health literacy and its effect on their ability to self-manage their diabetes. Collaboration with health care providers on addressing the day to day hurdles of diabetes management is also needed.

Conclusion

Despite timely medication refills and keeping SMBG logs 40% of the subjects did not attain optimal HgA_{1c} values. We believe that other unmeasured self-management behaviors may be vitally important in optimizing glycemic control in veterans. For example, health literacy, which is known to be lower in veterans, warrant further examination, as veterans need working knowledge in order to self- manage all aspects of their disease.

Table 1 Baseline Characteristics of Diabetic Veterans Enrolled in Vet Fitness (N=261)

	%	Mean	SD
Gender		1.03	.173
Male	96.9		
Female	3.1		
Age in Years		65.0	10.5
Race		1.67	.496
Caucasian	34.5		
African American	64.4		
Hispanic	1.1		
Service		4.2	1.76
WWII	10		
Korean	15.3		
Post Korean	8.8		
Vietnam	49.4		
Post Vietnam	10.3		
Persian Gulf	5.0		
CHAMPA	1.1		
Income		2.0	1.06
0-15,000	44.5		
15,001-25,000	22.5		
25,001-35,000	21.4		
35,001-45,000	11.6		
Service Connection		64.17	34.3
5-20%	23		
30-40%	11		
50-60%	10		
70-80%	14		
90-100%	42		
Employment			
Retired	46.4		
FT	14.2		
PT	1.9		
Disabled	1.9		
Unemployed	35.6		
Number of Visits		5.16	3.2

Table 2. Percent of veterans who maintained SMBG and refilled medications and HbA1c values.

N=261	%			
	Yes	No	Pre	Post
Log	33	66		
Medication refill	66	31.4		
HbA1c ≤ 7.5% (n)			(62) 23.7	(156) 59.8
HbA1c > 7.5% (n)			(193) 73.9	(98) 37.5

Table 3. Regression Analysis of predictors of glycemic control

	Estimate	Std. Error	R2	*t*	*p*
Medication refill A	0.53	0.12	0.05	3.12	.002*
SMBG log	0.05	0.17		0.32	0.75
Service era B			0.41		
Korea	-0.14	0.25		-0.55	0.58
Post Korea	0.23	0.30		0.74	0.46
Vietnam	-0.06	0.32		-0.19	0.85
Post Vietnam	0.07	0.46		0.16	0.87
Persian Gulf	-0.20	0.50		-0.41	0.68
CHAMPA	0.80	0.64		1.25	0.21
Number of visits	0.01	0.32	0.47	0.26	0.79
Race	0.38	0.97	0.05	0.39	0.69
Age	0.01	0.005	0.39	1.91	0.056

A – Model not adjusted for A_{1c} pre
B – Model adjusted for A_{1c} pre
*p significant at 0.05 level

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