

Self-Monitoring of Blood Glucose: A Pilot Review

Impact of Computer Software Modifications on Compliance

Anita D. Patel, BA, PharmD; Viktoria Kharlamb, PharmD; Arthur P. Reiter, BS, MS; and Ron Lovly, MS, RPh

INTRODUCTION

Diabetes mellitus is a complicated disease that affects more than 20% of people aged 60 or older.¹ According to the Centers for Disease Control and Prevention (CDC), 7% of the entire population in the U.S has diabetes.¹ Health care costs associated with this disease, as well as its complications and treatments, are very high. According to data from 2002, 11% of federal health care funds were spent on diabetes alone, and the direct cost of diabetes was estimated to be \$92 million for that year.² Federal data from 2005 showed that this spending rate increased to 12%. This cost includes medications and testing supplies such as blood glucose test strips. Veterans Integrated System Network 3 (VISN 3) of the Department of Veterans Affairs dispensed approximately 4.7 million test strips with an estimated cost of \$1.5 million for fiscal year 2006.

Blood glucose test strips are prescribed for approximately 13,740 patients with stable type-2 diabetes who are not taking insulin in VISN 3. Clinical Practice Guidelines, developed jointly by the Veterans Health Administration and Department of Defense (VHA/DoD), recommend that (1) diabetic patients who are not using insulin limit blood glucose testing to twice weekly and use no more than 50 strips every 150 days, and (2) patients taking oral agents may be eligible for an increased number of strips for a limited time period for various indications (Table 1).³

According to the American Diabetes Association (ADA), the optimal frequency of self-monitoring of blood glucose (SMBG) is not known for patients with type-2 diabetes.⁴ Few data exist to support the routine use of SMBG for improving glycemic control in patients with diabetes who are not using insulin.^{5,6}

Several review articles⁷⁻¹¹ and a clinical trial, published in 2007,¹² concluded that SMBG by patients who do not use insulin shows no clear effect on glycosylated hemoglobin (HbA_{1c}) levels. The VHA/DoD guidelines were developed on

the basis of clinical evidence showing that periodic HbA_{1c} testing was usually sufficient for monitoring glycemic control.^{3,5,9,13} The guidelines also provide recommendations for SMBG in patients who are using insulin.³

As a result of the VHA/DoD recommendations, VISN 3 implemented guidelines that allow two test strips per week (about 24 strips every 90 days) for diabetic patients not using insulin. However, prior to November 1, 2006, because of the limitations of the available computer software package that allowed for a maximum 90-day supply and the contracted test strip package size of 50, our local VISN 3 guidelines stated that patients who were not using insulin were limited to 50 test strips for a 90-day period unless the health care provider could document that the patient needed additional strips.

After November 1, 2006, the medical centers in VISN 3 implemented a modification of the computer software package that allowed more precise compliance with the VHA/DoD guidelines. Patients who were not using insulin could receive 50 strips for 180 days (two strips per week) unless more strips were warranted. The VISN 3 network's P&T committee advised health care providers about the new software and guidelines on the limited use of strips for patients not using insulin.

OBJECTIVE

Our primary objective in this pilot review was to evaluate adherence to VHA/DoD guidelines for SMBG by patients not using insulin therapy. We evaluated adherence both before and after the new computer software package was implemented. Our secondary objective was to determine the potential cost savings associated with the computer package, assuming a decreased use of blood glucose test strips for diabetic patients who were not using insulin.

METHODS

In August 2006, we used the medical center's computerized patient record system to generate a report of patients who received blood glucose test strips. Because we conducted the pilot review to determine whether the new computer software might have been effective in decreasing the number of test strips prescribed, we set out to evaluate a total of 100 patients. This was a random, relatively small number of patients who were selected for the initial evaluation. Ultimately, a larger number of patients would need to be evaluated in order to obtain statistically significant data.

We then conducted a retrospective manual chart review of 100 randomly selected patients. From the generated list, every 10th patient was randomly chosen. We reviewed the medical

Disclosure: The authors have no commercial or financial relationships to disclose in regard to this article.

At the time of this writing, Dr. Patel was a Pharmacy Practice Resident in the Department of Veterans Affairs at the New York Harbor Healthcare System in New York, New York. She is currently an Ambulatory Care Clinical Pharmacist at the VA Medical Center in Philadelphia, Pennsylvania. Dr. Kharlamb and Mr. Reiters are Clinical Assistant Professors at the Arnold & Marie Schwartz College of Pharmacy and Health Sciences, Long Island University, in New York. Dr. Kharlamb is also Senior Pharmacy Consultant, Mr. Reiter is Pharmacy Clinical Manager, and Mr. Lovly is Chief, all with the Veterans Integrated System Network 3 Pharmacy Benefit Management Program in the Department of Veterans Affairs at the New York Harbor Healthcare System.

Accepted for publication December 3, 2007.

Compliance and Self-Monitoring of Blood Glucose

chart to determine whether patients were using insulin or only oral agents. Patients using insulin were excluded, and the next name on the list was chosen. We followed this procedure in order to obtain a total of 20 patients from each site within the VISN 3 network. VISN 3 includes five sites: New York Harbor, Bronx, Hudson Valley, New Jersey, and Northport. Because we did not set out to evaluate the prescribing of test strips based on race or any other specific patient demographics, we made no attempt to obtain equal representation based on race.

Every VA medical center has computerized provider order entry (CPOE) and pharmacy records that are integrated both locally and nationally. When we searched the database, we captured all of the test strips dispensed during the selected time period from each center. Because the report could not eliminate each patient who was receiving insulin by electronic means, we conducted a manual chart review to make that determination.

We reviewed patients' records to determine whether the local recommendation of 50 strips for the 90 days was being followed. At that time, the computer package did not allow for more precise compliance with the VHA/DoD guidelines. If the recommendation was not being followed, we reviewed the progress notes to decide whether there was a valid reason, according to the guidelines, for the extra strips. Acceptable reasons included the following:

- if oral therapy was initiated
- if therapy was adjusted or changed
- if the health care provider decided that diabetes was not being well controlled (i.e., if patients were experiencing episodes of hypoglycemia or hyperglycemia).

We calculated the number of excess strips dispensed per month for patients who did not have a valid reason for receiving them. On the basis of the number of extra strips dispensed, we calculated the potential cost savings. To avoid discrepancies among reviewers, only one person reviewed the charts; no repeated extraction of the records was conducted by the

same individual.

To determine the success of the new computer software package, we conducted another review of the test strips filled in January 2007. Once again, we performed a retrospective manual chart review of 100 randomly selected patients. We reviewed 20 charts from each of the five medical centers in VISN 3. This time, we examined the prescriptions to learn whether the new recommendation—50 strips for 180 days—was being followed. If not, we re-reviewed the progress notes to learn whether there was an acceptable reason for the extra strips.

We evaluated only new or renewed prescriptions and excluded refills if the original prescription was written before November 1, 2006, the date on which the new computer software package was implemented. We then compared the August 2006 findings with the January 2007 reviews. After calculating the potential cost savings for each month and determining whether there were any differences between the two months, we extrapolated and calculated cost savings for all patients who were receiving test strips in VISN 3 and not using insulin.

RESULTS

Table 2 summarizes the results from the blood glucose test strip review of August 2006, prior to the cost savings initiative and the results of January 2007, after the cost-savings initiative was implemented.

Of 100 patients, 17 non-insulin-using patients (17%) were found to have received an excess number of test strips based on the local VISN 3 recommendation of 50 strips for 90 days in August 2006. According to the data, VISN 3 could have saved \$183.87 for the month of August 2006, with projected potential savings of \$2,206.44 annually on the 17 prescriptions for which the recommendation was not followed.

These dollar amounts were based only on the evaluation of 100 patients; if we had extrapolated them to include the entire population of non-insulin diabetic users of test strips in VISN 3 (13,740 patients), the potential projected annual savings would have been \$303,191. We assumed that prescriptions were always refilled on their due date.

Table 1 Management of Diabetes Mellitus

Recommendations for Self-Monitoring of Blood Glucose	
Patients using oral agents	For stable type-2 diabetes mellitus: no more than 50 strips per 150 days; this allows for twice-weekly testing. Additional strips may be needed for a limited time period for: <ul style="list-style-type: none"> • initiating therapy or adjusting oral agents, the meal plan, exercise, or activity. • detecting and preventing hypoglycemia if symptoms suggest its presence or if unawareness of hypoglycemia is documented. • detecting hyperglycemia if symptoms of urine glycosuria (in occasional patients using urine test strips) suggest its presence.
Patients using insulin	<ul style="list-style-type: none"> • Frequency of monitoring should be individualized according to the frequency of insulin injections, hypoglycemic reactions, level of glycemic control, and the patient's or health care provider's use of the data to adjust therapy. • Preprandial and postprandial tests should be performed up to four times per day.
Adapted from Veterans Health Administration/Department of Defense, December 1999 (Update 2003). ³	

Compliance and Self-Monitoring of Blood Glucose

Table 2 Results of Blood Glucose Test Strip Reviews in 100 Patients in the VISN 3 Network

	August 2006: No. of Prescriptions Overprescribed as per Guidelines: 50 Strips for 90 Days	January 2007: No. of Prescriptions Overprescribed as per Guidelines: 50 Strips for 180 Days
Site 1	4	3
Site 2	1	0
Site 3	1	3
Site 4	3	4
Site 5	8	2
TOTAL	17	12

After the initial prescribing visit, we did not determine further compliance; we assumed it. The VA's computer system did not allow patients to receive refills more than one week early unless the health care provider cancelled the prescription and entered a new one. In reality, this is seldom done, however; if the provider tries to enter a new prescription for the same item, the system emits a warning that the patient has recently

received the item. Therefore, we assumed that each patient received only one prescription of test strips during the allowed time period.

On the basis of the 100 patients evaluated in January 2007, approximately 12 patients (12%) who were not using insulin received extra test strips. We conducted this medication usage evaluation (MUE) two months after the new computer software package was implemented. According to this review, VISN 3 could have saved \$37.37 for the month of January 2007, with the potential savings of \$448.44 annually on the 12 prescriptions in which the recommendation of 50 strips for 180 days was not followed. Compared with the August 2006 data, this was a decrease in potential cost savings.

If we had extrapolated the January data to include the entire population of non-insulin users of test strips (13,740 patients), the potential projected annual savings would have been \$61,623 if all prescriptions had been dispensed according to recommendations and refilled on the due date. Comparing August 2006 findings with those of January 2007, we found the net annual potential cost savings extrapolated for VISN 3 to be \$241,568.

Table 2 shows considerable differences in compliance within the VA medical center. Because these were VA patients, they were similar in demographics—typically men over 65 years of age—but there could have been several reasons for the discrepancies among sites. Some sites might have had health care

Table 3 Cost Savings for Glucose Test Strips at the VISN 3 Network

	August 2006 MUE Before Initiative		January 2007 MUE After Initiative	
	Potential One-Month Cost Savings (N = 17)^a	Potential Annual Extrapolated Cost Savings (N = 17)^b	Potential One-Month Cost Savings (N = 12)^d	Potential Annual Extrapolated Cost Savings (N = 12)^e
Site 1	\$52.24	\$626.88	\$12.46	\$149.52
Site 2	\$10.45	\$125.40	\$0.00	\$0.00
Site 3	\$10.45	\$125.40	\$7.47	\$89.64
Site 4	\$36.57	\$438.84	\$9.96	\$119.52
Site 5	\$74.16	\$889.92	\$7.48	\$89.76
TOTAL	\$183.87	\$2,206.44	\$37.37	\$448.44
Annual potential cost savings extrapolated for VISN 3	\$303,191 (N = 2,336) ^c		\$61,623 (N = 1,649) ^f	
Net annual potential cost savings extrapolated for VISN 3	\$241,568			

^{a,b,c} Represent figures from the August 2006 medication usage evaluation (MUE). Of 100 charts reviewed, 17 prescriptions were written for an excess number of glucose test strips.

^c Represents cost savings that could be accrued if findings were extrapolated to the entire population of diabetic patients not using insulin and prescribed strips. Figure c depicts 17% of the entire number of test strip prescriptions for non-insulin-using patients (N = 13,740) for the entire Veterans Integrated System Network 3 (VISN 3). Therefore, 17% of 13,740 prescriptions = 2,336 prescriptions. If \$2,206.44 could be saved annually for 17 prescriptions, \$303,191 could be saved annually for 2,336 prescriptions if they were refilled on the due date.

^{d,e,f} Represent figures from the January 2007 MUE. In the 100 charts reviewed, 12 prescriptions were written for too many strips.

^f Represents cost savings that could be accrued if findings were extrapolated to the entire population of diabetic patients not using insulin who are prescribed test strips. Figure f depicts 12% of the total number of test strip prescriptions for non-insulin-using patients (N = 13,740) for the entire VISN; thus, 12% of 13,740 prescriptions = 1,649 prescriptions. If \$448.44 could be saved annually for 12 prescriptions, \$61,623 could be saved annually for 1,649 prescriptions if they were refilled on the due date.

continued on page 165

Compliance and Self-Monitoring of Blood Glucose

continued from page 160

providers who wanted their patients to check their blood glucose levels often and disagreed with the recommendations, or some sites might have encouraged their pharmacists to change the prescription to follow the recommendation.

Table 3 depicts the potential cost savings based on the findings of the August 2006 and January 2007 MUEs.

DISCUSSION

To increase compliance with VHA/DoD recommendations, the VISN 3 medical centers implemented a new computer software package. The package allowed patients who were not using insulin to receive 50 blood glucose test strips for 180 days unless the health care provider considered it necessary to prescribe more. The new recommendation was implemented on November 1, 2006.

Our pilot review revealed a reduction in excess strips prescribed in January 2007 (12%), compared with the number for August 2006 (17%). The new package has thus far improved compliance with VHA/DoD recommendations and has had a positive impact in decreasing the number of strips prescribed for diabetic non-insulin patients.

In addition to implementing software changes, the network P&T committee informed health care providers about the guidelines limiting the number of strips for patients not using insulin. Although the providers were informed both before and after the software change, they received more instruction after the change; network management concentrated on disseminating this information more aggressively because of the potential cost savings involved.

The outcome of our pilot review should result in significant cost savings—almost \$250,000—to VA medical centers (see Table 3). A larger sample size is needed to determine the actual statistical significance of compliance and the new computer software.

STUDY LIMITATIONS

Our evaluation was associated with several potential limitations:⁷⁻¹¹

- We reviewed only 100 prescriptions, a relatively small number.
- We analyzed data in August 2006, one month before the implementation of the new software package, and in January 2007, two months after the guidelines were implemented. Six-month data would have yielded a better representation of compliance.
- We examined the number of test strips per prescription, not the number of prescriptions per patient.
- We did not evaluate overall test strip use to include insulin-using patients as well as non-insulin-using patients.
- The overall impact on patient outcomes, such as analyzing HbA_{1c} for glycemic control, had not yet been assessed. In several studies, however, similar limitations in SMBG by diabetic patients not using insulin did not affect overall HbA_{1c} values and did not compromise patient care.

CONCLUSION

Implementing a new computer software package at our VA network in November 2006 helped reduce the number of

excess blood glucose test strips used by diabetic patients not needing insulin and has led to cost savings for VISN 3. We conducted the January 2007 review only two months after the new package was implemented. With more time and attention to the prescribing of test strips, this initiative should help to reduce the number of excess strips to a greater extent than that shown in the January 2007 findings. This improvement has the potential to lead to even greater cost savings than those identified in this article.

To increase compliance with the new guidelines and to decrease costs for medical centers, the new recommendation of 50 blood glucose test strips for 180 days needs to be re-emphasized for prescribers and pharmacists. Because this was a preliminary pilot review with a small sample size, we recommend that a larger number of prescriptions be examined and that statistical analyses performed in order to determine the differences realized with the new software.

Improved monitoring of HbA_{1c} levels should also be conducted to assess the potential impact on quality of health care.

REFERENCES

1. Centers for Disease Control and Prevention. National Diabetes Fact Sheet, United States 2005. Available at www.cdc.gov/diabetes/pubs/pdf/ndfs_2005.pdf. Accessed May 8, 2007.
2. American Diabetes Association. Direct and Indirect Costs of Diabetes in the United States. Available at: www.diabetes.org/diabetes-statistics/cost-of-diabetes-in-us.jsp. Accessed May 8, 2007.
3. Management of Diabetes Mellitus. VHA/DoD Clinical Practice Guideline Working Group. Veterans Health Administration, Department of Veterans Affairs and Health Affairs/Department of Defense. No.10Q-CPG/DM-03. Washington, DC: Office of Quality and Performance; December 1999 (Update 2003).
4. American Diabetes Association. Tests of glycemia in diabetes [position statement]. *Diabetes Care* 2004;27(Suppl 1):S91-S92.
5. Oki JC, Flora DL, Isley WL. Frequency and impact of SMBG on glycemic control in patients with NIDDM in an urban teaching hospital. *Diabetes Educ* 1997;23:419-424.
6. Meier JL, Swislocki AL, Lopez JR, et al. Reduction in the self-monitoring of blood glucose in persons with type 2 diabetes results in cost savings and no change in glycemic control. *Am J Manag Care* 2002;8(6):557-565.
7. Harris M. Frequency of blood glucose monitoring in relation to glycemic control. *Diabetes Care* 2001;24:979-982.
8. Rindone JP, Austin M, Luchesi J. Effect of home blood glucose monitoring on the management of patients with non-insulin dependent diabetes mellitus in the primary care setting. *Am J Manag Care* 1997;3:1335-1338.
9. Faas A, Schellevis FT, Van Eijk JTM. The efficacy of self-monitoring of blood glucose in NIDDM subjects: A criteria based literature review. *Diabetes Care* 1997;20:1482-1486.
10. Coster S, Gulliford MC, Seed PT, et al. Self-monitoring in type 2 diabetes mellitus: A meta-analysis. *Diabet Med* 2000;17:755-761.
11. Holmes V, Griffiths P. Self-monitoring of glucose levels for people with type 2 diabetes. *Br J Commun Nurs* 2002;7:41-46.
12. Farmer A, Wade A, Goyder E, et al. Impact of self-monitoring of blood glucose in the management of patients with non-insulin treated diabetes: Open parallel group randomized trial. *BMJ* 2007;335(7611):132.
13. Wieland LD, Vigil JM, Hoffman RM, et al. Relationship between home glucose testing and hemoglobin A_{1c} in type II diabetes patients. *Am J Health Syst Pharm* 1997;54(9):1062-1065. ■