Pharmacy Costs and Glycemic Control in the Department of Veterans Affairs

RUTH S. WEINSTOCK, MD, PHD[1,2]
GERALD HAWLEY, RN, MSN[3,4]
DENIS REPKE, PHD[3]
BARBARA L. FEUERSTEIN, MD[1,2]
CLARK T. SAWIN, MD[4]
LEONARD M. POGACH, MD, MBA[5,6]

OBJECTIVE — To determine pharmacy costs for glycemic treatment and its relationship to glycemic control in the Department of Veterans Affairs (VA) between 1994 and 2000.

RESEARCH DESIGN AND METHODS — Patients with diabetes in the VA in FY1994, FY1996, FY1998, and FY2000 were identified using an ambulatory care pharmacy-derived database. Total drug acquisition costs, as well as expenditures for insulin, oral glycemic control agents, and self–blood glucose monitoring strips, were determined for these veterans. HbA_{1c} levels for the corresponding time periods were also obtained. Pharmacy costs (medications and monitoring) were examined by glycemic control treatment type.

RESULTS — In FY2000, 18% (n = 535,016) of all VA pharmacy patients were identified as having diabetes, and they received 30% of all pharmacy prescriptions. Overall, 23% of pharmacy expenditures for these patients were related to glycemic control medications and monitoring supplies. Annual pharmacy costs increased from FY1994 to FY2000. The greatest change was the higher expenditure for monitoring supplies through FY1998, which then decreased in FY2000. Increased pharmacy costs were associated with improved glycemic control. In FY2000, the mean last HbA_{1c} level (n = 446,384) fell to 7.6% from 7.8% in FY1998 (n = 204,136) and 8.4% in 1996 (n = 53,348).

CONCLUSIONS — Diabetes was associated with high pharmacy costs. Increasing medication expenditures were associated with improved HbA_{1c} levels at the aggregated national level. Policies concerning dispensing monitoring supplies and several diabetes quality improvement projects were initiated during this interval. Future challenges include initiatives to further optimize care while controlling costs.

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Diabetes in the Department of Veterans Affairs (VA) is common and expensive, involving significant morbidity and mortality. The VA Healthcare Analysis and Information Group (formerly known as the National Center for Cost Containment) has been collecting data on the prevalence, pharmacy costs, and resource utilization of veterans with diabetes since 1994, documenting the financial burden of this disease. The prevalence of diabetes, patterns of prescribing glycemic medication and glucose monitoring, pharmacy costs, and hospital utilization related to diabetes in FY1994 have been previously described (1). In the current report, we compare medication-prescribing patterns, pharmacy acquisition costs, and glycemic outcomes to describe time trends and associations in the VA in FY1994, FY1996, FY1998, and FY2000.

RESEARCH DESIGN AND METHODS

— The VA Under Secretary for Health authorized the Healthcare Analysis and Information Group (HAIG) to conduct a series of burden-of-illness studies on diabetes using an ambulatory care pharmacy-derived database based on the voluntary submission of facility-level data. The four study time intervals were 1 October 1993 through 30 September 1994 (FY1994), 1 October 1995 through 30 September 1996 (FY1996), 1 October 1997 through 30 September 1998 (FY1998), and 1 October 1999 through 30 September 2000 (FY2000). The number of facilities participating in FY1994 was 62 (36% of the total number of facilities). In FY1996, there were 110 participating facilities (64%); in FY1998, there were 141 (97%); and in FY2000, there were 136 (100%). In FY1994 and FY1996, there were 172 independent facilities. In FY1998 and FY2000, as a result of facility-level integration, this number was reduced to 141 and 136 health care delivery systems, respectively.

Veterans with diabetes were identified from participating facilities using a pharmacy-derived database as previously described in detail (1). Briefly, a pharmaceutical classification based on the National Drug File classification of drug products, not generic ingredients, was used, which correlates directly with the U.S. Pharmacopeial classification system. Data retrieval methodology was predicated on the premise that glycemic control agents are the exclusive domain of two outpatient VA drug classes, HS501 (insulin) and HS502 (oral glycemic control agents), and that all glucose-monitoring strips utilized during the survey period were present in VA drug class DX900.

A previously validated software program was used to retrieve the unique social security numbers of veterans and

From the [1]VA Healthcare Network Upstate New York, Syracuse, New York; [2]SUNY Upstate Medical University, Syracuse, New York; [3]VA Healthcare Analysis and Information Group, Milwaukee, Wisconsin; [4]Office of the Medical Inspector, Department of Veterans Affairs, Washington, D.C.; [5]VA New Jersey Health Care System, East Orange, New Jersey; and [6]University of Medicine and Dentistry of New Jersey, New Jersey Medical School, Newark, New Jersey.

Address correspondence and reprint requests to Ruth S. Weinstock, MD, PhD, Department of Medicine (CWB 353), 750 East Adams St., Syracuse, NY 13210. E-mail: weinstor@upstate.edu.

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Abbreviations: VA, Department of Veterans Affairs.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

their medications from the VA's permanent Veterans Health Information Systems and Technology Architecture (**V***ist***A**) computer program. This list was matched against the laboratory file to extract glycosylated hemoglobin results for the corresponding time periods. It was assumed that insulin, oral glycemic control agents, and glucose-monitoring supplies were only used by persons with diabetes and that most veterans with diabetes treated in a VA facility obtain their medications through the VA pharmacies. Diet- and exercise-controlled patients with diabetes who received neither insulin nor oral agents are only identified if they received supplies for self-monitoring of blood glucose. It has been estimated that the diet and exercise group represents 27% of all people with type 2 diabetes, but many of these patients do not use monitoring supplies (2). The numbers presented, therefore, underestimate the total VA diabetes population.

Patients whose first diabetes-specific prescriptions occurred outside the study period were excluded. Veterans on insulin pumps were also excluded. In FY1998 and FY2000, there were 61 patients (<0.02% of total diabetes patients) and 194 patients (<0.04% of total diabetes patients) receiving insulin pump therapy, respectively.

Pharmacy costs

Drug acquisition costs were calculated for each patient during the four specified time periods. The program examined File 55 (Pharmacy Patient File), File 52 (Prescription File), and File 50 (Drug File) to determine whether a patient had received any drug in VA Classification HS501 (insulin), HS502 (oral glycemic control agents), or DX900 (glucose-monitoring strips). If a patient had received a prescription for one of these groups, the program calculated the number of prescriptions dispensed, adjusted to 30-day equivalents (<30 days' supply = 1 prescription; >30 and <61 days' supply = 2 prescriptions, and >60 days' supply = 3 prescriptions). Before FY2000, the software could not determine whether medications were prescribed sequentially or concurrently during the specified time period.

The program also calculated the cost for each of the drugs in the two user-defined drug groups, as well as the cumulative total cost and number of 30-day equivalents for all other drugs dispensed to the patient in the specified time period. The cumulative cost for a drug was calculated by multiplying the units dispensed with the unit cost. Excluded were the pharmacy labor costs for dispensing drugs and, before FY2000, those patients with diabetes-related pharmacy costs of >$10,000 or >$200 average cost per prescription because some VA pharmacy prescription files (e.g., individual strips versus bottle quantities for monitoring strips) are vulnerable to unit cost entry errors. In addition, patients with acquisition costs <75% or >125% of the predicted total cost for a drug item were excluded in FY1994 and FY1996. In FY1998, total costs for drug items exceeding these corridor limits were replaced with the predicted values. With the introduction of individual prescription detail in FY2000, these entry and acquisition errors were corrected when detected.

HbA_{1c} values

A variety of methods have been used to measure glycosylated hemoglobin. The selection of the laboratory assay was an individual facility decision. Only patients from facilities that utilized an HbA_{1c} method were included in the laboratory analysis (n = 53,348 in FY1996, 222,595 in FY1998, and 466,384 in FY2000). Since the National Glycosylated Hemoglobin Standardization Program did not begin until 1997 and participation was voluntary until FY2000, inclusion was based on review of submitted methods and reference ranges as well as subsequent telephone confirmation. The patient's last HbA_{1c} test reported during the study period was used for the analysis.

RESULTS

Prevalence and outpatient pharmacy costs

For FY1994, 120,664 unique patients receiving diabetes prescriptions were identified from the 62 participating facilities. There were 204,472 unique patients identified from 110 hospitals in FY1996, 348,339 unique patients from 141 facilities in FY1998, and 535,016 unique patients from 136 facilities during FY2000.

In FY1994, 12% of all veterans from participating facilities received diabetes-related prescriptions and, therefore, were identified as having diabetes. These patients were responsible for 24% of total VA direct pharmaceutical and supply costs. In FY1998 and FY2000, respectively, using the pharmacy-derived database, patients identified as having diabetes were ~12.5% (n = 348,339) and 18% (n = 535,016) of the total VA pharmacy user population. These veterans received 28 and 30% of all pharmacy prescriptions, respectively, which represented 25 and 28% of all pharmacy dollars expended. These include all pharmacy costs, not only medications related to diabetes. The mean total pharmacy cost during FY2000 for veterans with diabetes was 79% higher than those without diabetes (data not shown).

People with diabetes are prescribed many classes of medications, including those related to controlling blood glucose levels. Overall, 27% of all VA pharmacy expenditures were related to glycemic control medications and monitoring supplies during FY1998; this decreased to 23% in FY2000. When examined by type of glycemic control medication in FY1998, 28% of all pharmacy expenditures for insulin users were devoted to glycemic control, 22% for oral agent users, 37% for patients taking both insulin and oral agents, and 14% for patients who did not receive insulin or oral agents. In FY2000, 20% of all pharmacy expenditures for insulin users were devoted to glycemic control, 23% for oral agent users, 30% for patients taking both insulin and oral agents, and 8% for patients who did not receive insulin or oral agents. Furthermore, 56% of veterans receiving glycemic control medications and supplies were prescribed blood glucose–monitoring strips in FY1998; this value increased to 60% in FY2000. Other pharmacy costs include medications related to the treatment of hypertension, heart disease, lipid disorders, renal disease, and other comorbid conditions (data not shown).

Pharmacy expenditures for veterans with diabetes were further examined by the type of glycemic control treatment in 141 VA facilities during FY1998 and in 136 facilities in FY2000. Treatment with oral agents was received by 61% (62% in FY2000) of veterans with 55% (50% in FY2000) of these patients also receiving monitoring supplies. Insulin was used by 25% (18% in FY2000) of veterans with diabetes, and both insulin and oral agents were used by 12% (15% in FY2000). Glucose-monitoring supplies were dispensed

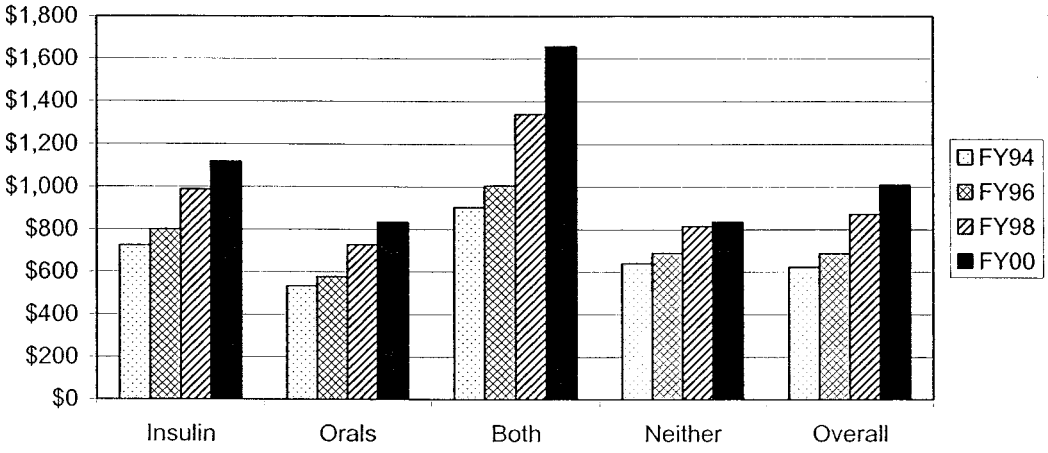

Figure 1—*Mean total annual pharmacy expenditures ($/patient with diabetes) for drugs and supplies in the VA for FY1994, FY1996, FY1998, and FY2000.*

to 70% (71% in FY2000) of the insulin users (data not shown).

Figure 1 depicts the mean total annual pharmacy expenditures for VA diabetes patients in FY1994, FY1996, FY1998, and FY2000. Total costs increased in all groups, regardless of whether insulin or oral glycemic control agents were prescribed. Overall annual mean pharmacy costs were $873 and $1,010 for each veteran with diabetes in FY1998 and FY2000, respectively. For patients prescribed insulin, the annual costs were $988 and $1,119. Mean total annual pharmacy expenditures were highest for patients taking both insulin and oral agents ($1,340 in FY1998 and $1,658 in FY2000) and lower for veterans using only oral agents ($729 in FY1998 and $835 in FY2000).

The average total pharmacy costs for patients receiving outpatient continuity of care in the VA, defined as at least two outpatient primary or diabetes care visits separated by a minimum of 6 months (180 days), were also examined for FY1998 and FY2000. Applying this definition, 44% (41% in FY2000) of the patients received continuity of care in FY1998. The mean total costs for these continuity-of-care patients were 64% ($412 per veteran) higher in FY1998 and 54% ($414 per veteran) higher in FY2000 than the overall average costs for diabetes patients not receiving continuity of care at the VA. For veterans receiving insulin alone, costs were 58% ($437) higher in FY1998 and 58% ($494) higher in FY2000 in the continuity-of-care group. Expenditures were 65% ($349) higher in FY1998 compared with 67% ($406) higher in FY2000 for patients receiving oral agents, 47% ($481) higher in FY1998 compared with 2% ($31) higher in FY2000 for patients receiving both insulin and oral agents, and 67% ($425) higher in FY1998 compared with 64% ($389) higher in FY2000 for patients receiving monitoring supplies alone. For patients receiving ongoing primary or diabetes outpatient care in FY1998 and FY2000, respectively, average blood glucose–monitoring supply costs were $60 and $57 higher in the insulin-using group, $25 and $23 higher in the oral agent group, $56 and $50 higher in the oral agent and insulin group, and $31 and $12 higher in the monitoring only group.

Figure 2 shows mean annual pharmacy expenditures for medications and glucose-monitoring supplies related to glycemic control in veterans treated with insulin and/or oral agents. These costs have increased significantly in all groups over the 3 fiscal years examined from FY1994 to FY1998, but overall remained steady in FY2000. The costs related to glycemic control were 22, 21, 27, and 23% of total pharmacy expenditures for patients with diabetes during FY1994, FY1996, FY1998, and FY2000, respectively. The annual total glycemic control pharmacy costs in FY1998 were $232 per veteran with diabetes as compared with $236 in FY2000. Glycemic control expenditures for patients taking oral agents in FY1998 were $160 ($190 in FY2000). The highest costs were observed in the

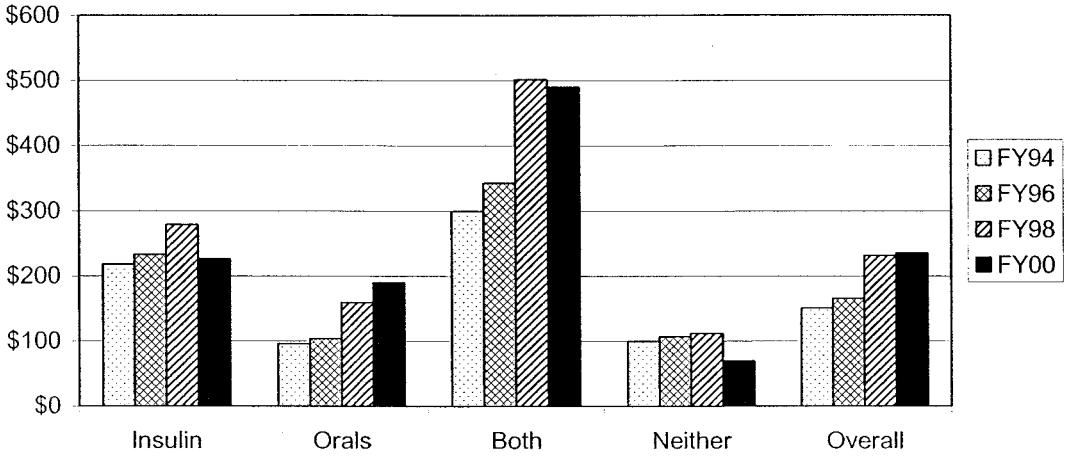

Figure 2—*Mean annual glycemic control pharmacy expenditures ($/patient with diabetes) for drugs and supplies in the VA for FY1994, FY1996, FY1998, and FY2000.*

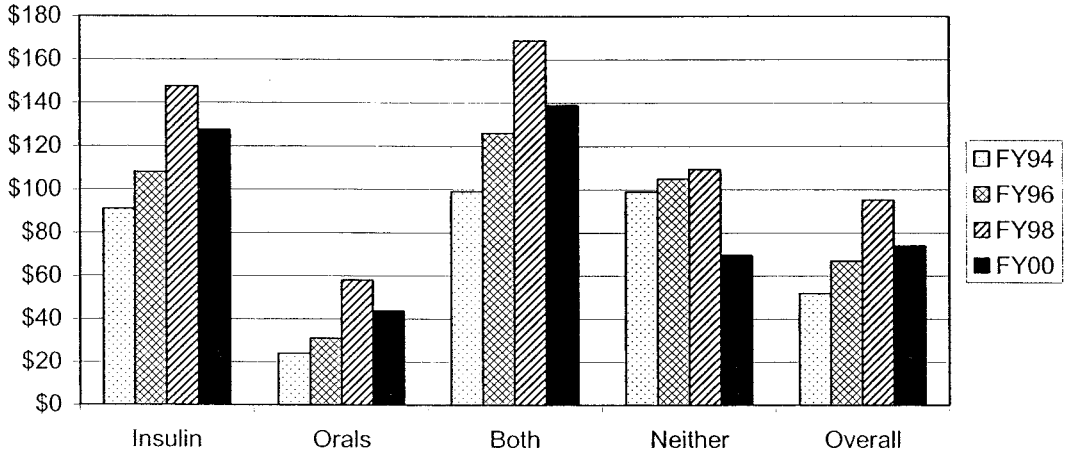

Figure 3—*Mean annual glucose monitoring pharmacy expenditures ($/per patient) for self-blood glucose monitoring supplies in veterans with diabetes in the VA for FY1994, FY1996, FY1998, and FY2000.*

insulin users ($279 in FY1998 and $227 in FY2000) and patients using both insulin and oral agents ($501 in FY1998 and $490 in FY2000).

Pharmacy costs include the costs of glucose-monitoring supplies as well as medications. Figure 3 shows the increasing mean costs of annual blood glucose–monitoring supplies in the VA in diabetes patients receiving blood glucose monitoring and treated with insulin and/or oral agents from FY1994 to FY2000. During this period of time, the unit cost for monitoring supplies remained relatively stable. In FY1998, 56% of the patients with diabetes received blood glucose–monitoring supplies. This utilization increased to 60% in FY2000. Using all patients with diabetes as the denominator, in FY1994 the mean annual expenditure for these supplies was $52, and these costs increased to $67 and $95 in FY1996 and FY1998, respectively, and then decreased to $74 in FY2000. The cost of blood glucose–monitoring supplies was 11, 10, 11, and 7% of total pharmacy costs for these veterans in FY1994, FY1996, FY1998, and FY2000, respectively.

Using those patients with diabetes receiving blood glucose monitoring as the denominator, in FY1996 the mean annual expenditure for these supplies was $149, which increased to $170 in FY1998 and then decreased to $123 in FY2000. Highest costs were observed in patients using insulin with ($215 in FY1998 and $175 in FY2000) or without ($213 in FY1998 and $180 in FY2000) oral agents.

In FY1998 and FY2000, for patients taking insulin, oral agents, or using both, the cost of glucose monitoring was 53 and 56%, 36 and 23%, and 34 and 28%, respectively, of all glycemic control expenditures. Overall, in FY1998 and FY2000, self-monitoring expenditures represented 41 and 31%, respectively, of total annual glycemic control pharmacy costs. The average annual monitoring costs for patients receiving blood glucose monitoring in FY1998 and FY2000 were $142 and $98 in the overall population, as compared with $185 and $135 in the veterans receiving ongoing outpatient care (defined as at least two primary care or diabetes outpatient visits at least 180 days apart). Because the unit cost of monitoring strips did not significantly change, these lower expenditures in FY2000 reflect a decrease in the quantity of supplies dispensed. It should be noted that guidelines for dispensing monitoring supplies were distributed in 1997. These guidelines suggested that self monitoring frequency should be limited to about twice weekly for patients on oral agents who had stable glycemia without symptoms.

Oral glycemic control agents

Oral glycemic control agents were the most common glycemic control medications prescribed in the VA. This was not unexpected, since most veterans with diabetes have type 2 diabetes. Of the total number of patients prescribed oral glycemic control agents in the VA during FY1998 and FY2000 (n = 255,024 and 413,267, respectively), the most commonly prescribed oral agents were second-generation sulfonylurea drugs (86% of all oral agent users in FY1998 and 80% in FY2000): glyburide (63 and 54%), glipizide (25 and 27%), and glimepiride (0.1 and 0.5%). Metformin followed with 34% (FY1998) and 50% (FY2000) utilization (Table 1). This is a threefold increase in the percentage of patients treated with metformin in FY2000 compared with FY1996. There were relatively few prescriptions for first-generation sulfonylurea drugs during FY1998 and FY2000: tolazamide (2.0 and 0.8%, respectively), tolbutamide (0.4 and 0.2%), chlorpropamide (0.8 and 0.3%), and acetohexamide (0.007 and 0.003%). The α-glucosidase inhibitors acarbose and miglitol accounted for 1.9 and 1.9%, respectively, of the overall oral agent utilization during FY1998 and FY2000, and thiazolidinediones accounted for 2.8 and 6.4%. Thiazolidinediones were not available in 1996, and only troglitazone was available in FY1998. These data are in agreement with VA diabetes management guidelines, which suggested initiation of oral agent therapy with second-generation sulfonylurea drugs, based on their cost-effectiveness in lowering HbA_{1c} values compared with metformin (3), as well as on their safety profile. As shown in Table 2, the low unit cost for glyburide decreased further from FY1994 to FY2000, whereas the higher unit cost for metformin remained about the same.

The percentage of patients receiving single oral agent therapy in FY2000, by medication, is also shown in Table 1. For FY2000, 63.67% (n = 263,018) of patients prescribed oral agents were receiving monotherapy. Thirty-six percent were prescribed multiple oral agents (n = 150,227), and 79,480 were prescribed any oral agent in combination with insulin. Overall, 413,245 veterans were prescribed an oral agent in FY2000. Again, sulfonylurea drugs predominate. Troglitazone, the most expensive agent, was not available in 1996. Annual expenditures for metformin and acarbose increased

Table 1 —*Veterans receiving oral glycemic control agents as monotherapy or combination therapy in the VA in FY2000*

	Single oral agents			>1 Oral agent			
Agent	Without insulin	With insulin	Total	Without insulin	With insulin	Total	Total
Sulfonylurea (first generation)	3,170 (0.8)	234 (0.1)	3,404 (0.8)	1,806 (0.4)	222 (0.1)	2,028 (0.5)	5,432 (1.3)
Average cost/patient*	33.08	36.56	33.32				
Sulfonylurea (second generation)	166,121 (40.2)	21,049 (5.1)	187,170 (45.3)	122,061 (29.5)	22,280 (5.4)	144,341 (34.9)	331,511 (80.2)
Average cost/patient	19.78	34.39	21.42				
Metformin	38,220 (9.2)	26,443 (6.4)	64,663 (15.6)	118,082 (28.6)	22,952 (5.6)	141,034 (34.1)	205,697 (49.8)
Average cost/patient	173.86	213.14	189.93				
α-Glucosidase inhibitors	495 (0.1)	561 (0.1)	1,056 (0.3)	4,928 (1.2)	1,987 (0.5)	6,915 (1.7)	7,971 (1.9)
Average cost/patient	135.62	145.90	141.08				
Repaglinide	83 (0.0)	29 (0.0)	112 (0.0)	236 (0.1)	94 (0.0)	330 (0.1)	442 (0.1)
Average cost/patient	250.16	288.79	260.16				
Thiazolidinediones	1,198 (0.3)	5,415 (1.3)	6,613 (1.6)	12,587 (3.0)	7,279 (1.8)	19,866 (4.8)	26,479 (6.4)
Average cost/patient	343.31	537.78	502.55				

Data are *n* (%) of all patients receiving any oral agent(s). *Cost for specified oral agent(s).

from FY1996 to FY1998 ($152 to $195 for metformin and $65 to $121 for acarbose), whereas the most commonly prescribed second-generation sulfonylurea drug costs decreased from $73 to $33. Table 1 shows mean costs for glycemic agents when used as monotherapy or in combination with insulin in FY2000. Sulfonylurea drugs remain the least expensive, whereas thiazolidinedione costs were considerably higher.

Glycemic control

Improved glycemic control decreases microvascular complications in type 2 diabetes, the most common form of diabetes in the VA, and is associated with increased treatment costs (3,4). In 1997, the VA developed Clinical Practice Guidelines for the Treatment of Persons with Diabetes, and instituted nationwide performance measures, which included that each veteran with diabetes have at least an annual HbA_{1c} test. In addition, the number of individuals with very poor glycemic control, defined as HbA_{1c} >10%, was monitored. Pharmacy costs for glycemic

Table 2 —*Unit cost of representative glycemic control medications, FY1994–2000*

Medication	FY1994	FY1996	FY1998	FY2000
Glyburide 2.5 mg tab	0.06 ± 0.01	0.04 ± 0.01	0.03 ± 0.02	0.020 ± 0.018
Glyburide 5 mg tab	—	—	—	0.024 ± 0.011
Glipizide 5 mg tab	0.16 ± 0.00	0.09 ± 0.07	0.05 ± 0.05	0.034 ± 0.040
Glipizide 10 mg tab	0.30 ± 0.03	0.06 ± 0.04	0.09 ± 0.11	0.054 ± 0.072
Glimepiride 2 mg tab	—	0.31 ± 0.00	0.22 ± 0.04	0.181 ± 0.052
Glimepiride 4 mg tab	—	—	—	0.313 ± 0.097
Metformin HCL 500 mg tab	—	0.29 ± 0.00	0.29 ± 0.03	0.290 ± 0.007
Metformin HCL 850 mg tab	—	—	—	0.507 ± 0.081
Metformin HCL 1000 mg tab	—	—	—	0.559 ± 0.076
Acarbose 50 mg tab	—	0.29 ± 0.00	0.28 ± 0.01	0.27 ± 0.017
Pioglitazone 15 mg tab	—	—	—	1.56 ± 0.180
Pioglitazone 30 mg tab	—	—	—	2.64 ± 0.062
Rosiglitazone 2 mg tab	—	—	—	1.11 ± 0.131
Rosiglitazone 4 mg tab	—	—	—	1.47 ± 0.062
Rosiglitazone 8 mg tab	—	—	—	2.66 ± 0.241
Troglitazone 200 mg tab	—	—	2.09 ± 0.50	1.86 ± 0.203
Troglitazone 400 mg tab	—	—	—	2.95 ± 0.204
Human 70/30 insulin vial	5.10 ± 0.08	5.15 ± 0.78	5.45 ± 1.89	4.56 ± 0.964
Human NPH insulin vial	3.90 ± 1.96	5.14 ± 0.79	5.39 ± 1.46	4.49 ± 0.662
Human regular insulin vial	3.90 ± 1.96	5.11 ± 0.81	5.39 ± 1.47	4.51 ± 0.661
Human lispro insulin vial	—	—	—	14.62 ± 4.53
Tolazamide 250 mg tab	0.06 ± 0.03	0.05 ± 0.01	0.05 ± 0.01	0.046 ± 0.017
Chlorpropamide 250 mg tab	0.04 ± 0.08	0.02 ± 0.01	0.07 ± 0.27	0.108 ± 0.088
Tolbutamide 500 mg tab	0.02 ± 0.01	0.03 ± 0.05	0.02 ± 0.00	0.057 ± 0.038

Data are means ± SD.

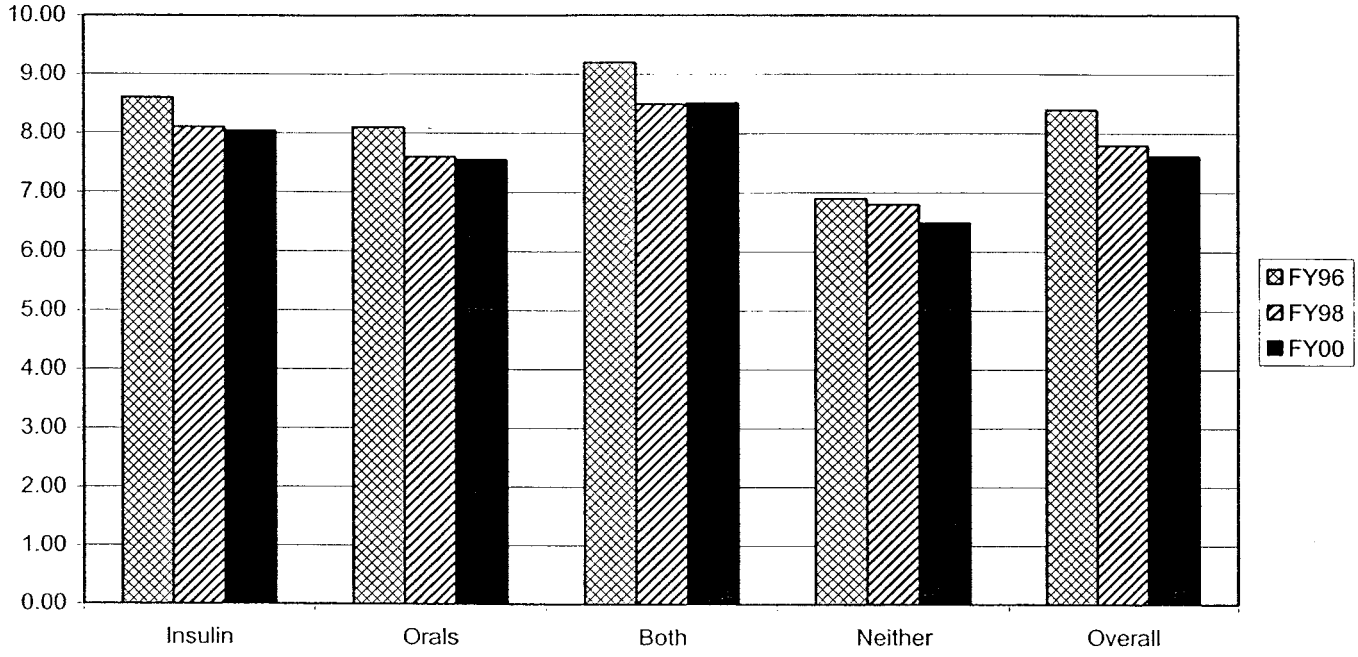

Figure 4—*Mean HbA_{1c} levels (%) for veterans with diabetes in the VA for FY1996* (n = *53,348), FY1998* (n = *222,595), and FY2000* (n = *446,384).*

control medications have steadily increased in the VA from FY1994 to FY2000. However, the increased costs have been linked to improved glycemic outcomes.

In FY2000, the mean last HbA_{1c} among veterans from 136 facilities (n = 446,384) was 7.6% (SD 1.79, 95% CI 0.005) and the median was 7.2%, while in FY1998, the mean last HbA_{1c} among veterans from 105 facilities (n = 222,595) was 7.8% (1.82, 0.008) and the median was 7.5%. As shown in Fig. 4, this represents a decrease in mean HbA_{1c} from 1996, when the mean value was 8.4% (n = 53,348, SD 2.14, 95% CI 0.018). In the largest subgroup, (i.e., veterans taking oral agents), the mean last HbA_{1c} was 7.6% in FY1998 (n = 119,361, SD 1.76, 95% CI 0.01, median 7.3%) and remained at 7.6% in FY2000 (n = 246,189, SD 1.70, 95% CI 0.007). For the insulin-alone users, the mean last HbA_{1c} in FY1998 was 8.1% (n = 47,505, SD 1.85, 95% CI 0.017, median 7.8%), which decreased to 8.0% in FY2000 (n = 67,638, SD 1.85, 95% CI 0.014). The mean HbA_{1c} among veterans who took both insulin and oral agents was 8.5% in FY1998 (n = 26,321, SD 1.95, 95% CI 0.024, median 8.2%) and also 8.5% in FY2000 (n = 65,193, SD 1.93, 95% CI 0.015). This group presumably included those veterans with the most difficult to control type 2 diabetes. For patients receiving monitoring supplies but no glycemic control medication for their diabetes, the mean HbA_{1c} was 6.8% in FY1998 (n = 2,035, SD 1.33, 95% CI 0.058, median 6.6%), which decreased to 6.5% in FY2000 (n = 16,974, SD 1.10, 95% CI 0.016). This excellent control confirmed their lack of need for pharmacological therapy.

CONCLUSIONS — Before FY1997, outpatient ICD-9-CM codes were not available in the VA. The pharmacy-derived database was therefore the best available method to identify patients with diabetes. A chart review conducted at a single VA Medical Center suggests that our identification criterion (one or more prescriptions) results in very few false-positive identifications (1–2%) but probably underestimates the number of patients with diabetes receiving regular care in the VA by as much as 5−10%.

Because patients with pharmacologically treated diabetes account for ~73% of all persons with type 2 diabetes (2), our database underestimates the true prevalence of diabetes in the VA. The registry, however, probably does identify all of the pharmacy-associated costs from the VA. The overall HbA_{1c} levels may also be biased toward a higher mean, since most of the diet-controlled patients were not identified and therefore excluded. Consequently, valid comparisons of mean glycemic levels can only be made with plans or agencies that do not use a hybrid approach (ICD-9-CM codes and a pharmacy database) to identify their population of persons with diabetes.

Higher costs may result, in part, from the introduction of newer, more expensive oral agents, including metformin and acarbose in FY1996, troglitazone in FY1998, and pioglitazone and rosiglitazone in FY2000, and the increasing use of combination therapy with these agents. The unit price of these drugs did not change substantially from FY1996 to FY2000, but an increased usage and a larger dose of several of these drugs was noted in FY2000.

Based on a systematic review of the literature in 1997 and 2000, the VA Clinical Practice Guidelines recommended initiation of oral therapy with sulfonylurea drugs, which have equal efficacy in lowering HbA_{1c} compared with biguanides (metformin) and thiazolidiones but lower cost. Based on recent systemic reviews, these conclusions are still valid (5,6). Metformin was considered the second-line oral agent. The unit price of the most commonly prescribed oral glycemic control medication, glyburide, also de-

creased during this time. However, the greatest change was the rise in expenditures for monitoring supplies through FY1998. The percentage of patients using self-monitoring supplies (56% in FY1996, 57% in FY1998, and 60% in FY2000) and the unit cost of monitoring supplies did not significantly change, but the overall number of monitoring strips dispensed significantly increased through FY1998. The appropriateness of indication for the monitoring strips and patient adherence could not be assessed from the database. Despite the fact that no study has yet demonstrated the benefit of self-monitoring in persons with type 2 diabetes, the subject remains controversial (7,8). The increased use and cost of monitoring supplies, however, represented a major source of the higher pharmacy costs. In 1997, monitoring guidelines became effective and suggested limiting the number of strips dispensed. This resulted in decreased monitoring expenditures in FY2000, with no deterioration in glycemic control on a population basis.

The patient-level pharmacy costs in this study are an underestimate of the costs of treating veterans on an annual basis. Costs for veterans identified in the continuity-of-care group had higher pharmacy costs for glycemic control, which was mostly due to increased medication expenditures. The pharmacy-related costs would be even higher for these veterans if cared for outside of the VA, since unit medication costs tend to be less expensive in the VA. VA medications and supplies are typically discounted well below average wholesale pricing. Not included in the pharmacy costs were the costs associated with filling the prescriptions. Since persons with diabetes had nearly twice as many annual prescriptions compared with persons without diabetes, the use of direct pharmacy costs underestimates the total pharmacy-related costs associated with diabetes.

It is difficult to directly compare the VA costs with other health plans since patients cared for in the VA tend to be mostly older and male, to have predominantly type 2 diabetes, and to have more comorbid conditions (9,10). The VA annual pharmacy costs were $688 in FY1996, $873 in FY1998 (mean HbA_{1c} 7.8%), and $1,010 in FY2000 (mean HbA_{1c} 7.6%). High pharmacy costs for people with diabetes, however, have been reported in a number of settings (11–18). Selby et al. (11) reported that total HMO expenditures for diabetes in 1994 were 2.4 times those of members without diabetes, which represented $3,500 per year per diabetes member of excess cost. The pharmacy costs accounted for 9.4% of this excess cost. Insulin treatment was also associated with higher costs (4). In reports from Finland, 8.8% of the costs of drug-treated diabetes patients in 1989 were due to medication costs (12), and in 1995, total drug costs for type 2 diabetes patients were three times higher than for those without diabetes (18). In Germany in 1994, diabetes patients (7.9% of all patients) were responsible for 21% of annual prescription costs (13). In the U.S. in managed care plans that utilized Diabetes Treatment Centers of Americas Diabetes NetCare, annual pharmacy costs for diabetes patients were reported to be $792 per member in 1996 (mean HbA_{1c} 8.9%) and increased to $912 per member in 1997 (mean HbA_{1c} 8.5%) (14). Direct comparisons, however, need to be interpreted with caution, since the populations studied differ and are not adjusted for case mix or inflation.

These administrative data demonstrate a decrease in HbA_{1c} levels between FY1996 and FY1998 and again between FY1998 and FY2000. In comparison, chart reviews performed by the VA External Peer Review Program show that 51% of VA patients with diabetes who had at least three primary care or medical subspecialty visits within a year had a glycosylated hemoglobin test performed at least once in FY1995, whereas 91% received a glycosylated hemoglobin test in FY1998, a marked improvement (19). The percentage of veterans with an HbA_{1c} >10% also decreased from 24 to 13% during this time (19). This reduction would be expected to reduce health care utilization and costs (20). It is likely that these decreases in HbA_{1c} levels and increases in the performance of this test are a result of the dissemination of medical knowledge, newer oral agents, the publication and mandating of VA Clinical Guidelines for the Treatment of Patients with Diabetes, and the introduction of mandated performance measures including the performance of HbA_{1c} tests.

We describe an association between increasing drug acquisition costs and improved HbA_{1c} levels in the VA. These results are relevant to proposals to provide pharmacy benefits to Medicare enrollees. First, the average age of the veteran with diabetes in the VA is 67 years, and the prevalence of diabetes increases with age. Second, while not preventing clinicians from prescribing medications for an individual, the VA formulary guidelines recommend prescribing less expensive oral agents first for persons with type 2 diabetes based on the effectiveness and safety of the medications. In addition, while recognizing that monitoring may be beneficial for an individual patient with type 2 diabetes, the guidelines emphasized that there were no controlled studies that demonstrated a benefit of increased monitoring. Despite dispensing fewer monitoring supplies in FY2000, there was no deterioration in glycemic control.

In summary, annual pharmacy costs for patients with diabetes increased in the VA from FY1994 to FY2000. The rise in glycemic control–related pharmacy costs between FY1994 and FY1998 was primarily associated with dramatically increased costs of monitoring supplies. Since the cost of these supplies remained relatively stable, these higher expenditures reflect a rise in the amount of glucose monitoring supplies dispensed. The use of newer more expensive oral glycemic control agents and combination therapy also contributed to these higher costs, especially in FY2000, when monitoring costs decreased. From FY1994 to FY2000, several quality improvement efforts were underway to improve diabetes care in the VA. By FY1998, most veterans with diabetes had received an HbA_{1c} test (91%), and the mean HbA_{1c} decreased to 7.8%. The increasing costs were associated with improved glycemic control. The challenge of the future will be to control expenditures without compromising the quality of care.

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