Multiple Interventions to Improve Provider Adherence to Diabetes Care Guidelines

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Abstract

• **Objective:** To assess the impact of provider education and systems improvements on attainment of clinical goals for patients with diabetes, and to compare the outcomes of patients who received care from an interdisciplinary team with those patients who received care from their primary care physician (PCP).

• **Setting:** United States Air Force ambulatory care clinic.

• **Measures:** Primary measures were hemoglobin A1c (HbA1c) values and low-density lipoprotein cholesterol (LDL) and blood pressure levels. Secondary measures were frequency of annual recommended screening (foot and eye exams, microalbuminuria test, measurement of serum creatinine) and utilization of selected indicated drug therapies.

• **Results:** 100 charts were evaluated at baseline and 111 postintervention; 57 of the postintervention patients received team care, and 54 were cared for by their PCPs. Mean HbA1c values were lower postintervention (7.85 versus 7.25, \( P = 0.007 \)) and more patients had achieved blood pressure goal (29.4%, versus 25.2% at baseline, \( P = 0.009 \)). Aspirin use also increased postintervention (38% versus 54%, \( P = 0.02 \)). Team patients had lower mean HbA1c levels (\( P = 0.007 \)) and were more often at goal as compared with PCP patients (\( P = 0.034 \)).

• **Conclusion:** Multiple interventions in a primary care clinic may improve annual screening rates and diabetes control.

Diabetes mellitus is a chronic, progressive disorder that leads to significant morbidity and mortality and imposes a large economic burden. The annual direct and indirect costs of type 2 diabetes are estimated at $98 billion, and per capita annual health care expenditures for patients with diabetes runs 3 times the national average [1–4]. Although there have been major advances in the diagnosis and treatment of diabetes, estimates suggest that only 59 of the 17 million people with diabetes have been diagnosed and that the risk of associated complications has increased [4]. The American Diabetes Association (ADA) has published clinical practice recommendations [5], but adherence to the recommendations and achievement of ADA clinical goals is suboptimal [6,7].

Multiple interventions to change physician behavior appear to be more effective than single interventions [7–10]. In this paper, we describe the development and implementation of multiple interventions intended to improve adherence to ADA guidelines and achievement of diabetes clinical targets. Additionally, we assessed the outcomes of patients who received care from an interdisciplinary team as compared with patients who received standard care from their primary care providers (PCPs).

Methods

Setting

Our study was conducted in a United States Air Force ambulatory care clinic. Twenty-four primary care providers (15 MDs, 1 DO, 4 physician assistants, 4 nurse practitioners) at the clinic care for approximately 20,000 patients.

Intervention

In developing the intervention, a Diabetes Mellitus Working Group was formed comprising 2 clinical nurses, an internal medicine physician, a dietitian, a clinical pharmacist, a psychologist, and an administrative quality assurance representative. The Chief of the Medical Staff convened the group and was the group’s internal medicine representative. The group was charged with developing a multidisciplinary approach to diabetes care with the goal of improving adherence to ADA practice standards. The group met twice per month for 6 months. Team members reviewed the literature, talked with others in their discipline, and drew on their own expertise to determine how to best enhance the continuing care of diabetes patients.
The intervention consisted of 2 main components: a pharmacist-managed diabetes clinic and diabetes education classes. Together, this was referred to as “team care.” Patients could be referred to team care by any PCP by marking a checkbox on a form kept in the examination rooms; the form was then forwarded to the nurse assigned to that provider. The nurse was responsible for scheduling the patient for diabetes education classes, either in person at the office or by phone.

Patient education. Classes were held at the clinic in a small classroom and met once per week for 4 weeks. Patients started with class one. If they missed a week, they could make it up the next month. Class was held as long as there was at least 1 student. Presenters represented a range of disciplines including dentistry, optometry, psychology, and exercise physiology. Classes consisted of didactic presentation of information as well as demonstrations and activities (eg, basic foot exam, fingerstick technique, creating a meal plan). Time was also given to discuss personal challenges within the group. After attending all of the classes, patients were asked to complete a questionnaire that assessed diet, lifestyle habits, and knowledge and to take the completed questionnaire to their next visit with their PCP. PCPs were responsible for questionnaire interpretation and referral for additional education.

The pharmacist-managed clinic. Appointments for team patients to attend the pharmacist-managed clinic were scheduled at the end of the first diabetes education class by the pharmacist. During clinic visits, the pharmacist reviewed medications, made dose adjustments when needed, educated patients, identified missing lab work, and reviewed charts for guideline adherence. Pharmacists were unable to order laboratory tests, so recommendations for testing in accordance with guidelines were noted in the medical record and appointments to see the PCP for follow-up were scheduled. Pharmacists also made referrals for appointments with an exercise physiologist, podiatrist, nutritionist, optometrist, and psychologist and made patients aware of tobacco cessation, healthy cooking, and stress management classes, which were open to the entire beneficiary population. Two pharmacists were responsible for the clinic. Appointments averaged 30 to 60 minutes. Intervals between appointments were individualized based on patient needs but were rarely greater than 3 months. The facility’s automated reminder system called patients to remind them of all of their appointments. Patients continued to see their PCP as before.

Other aspects of team care. Medical technicians labeled the charts of team patients with a blue sticker and attached 10-g monofilaments to their medical records. A Diabetes Care Record was developed and placed in all team patient charts and used consistently in the pharmacist-managed clinic. These aspects of care were available to all PCPs, but only if they requested it.

Prior to implementing the team care intervention, the Diabetes Mellitus Working Group provided education on diabetes for all staff. Providers, nursing staff, and medical technicians were invited to eight 1-hour educational sessions that covered key topics in diabetes clinical care (eg, foot care, hypertension, dyslipidemia, obesity, medication management). Sessions were offered monthly, with presenters representing a range of disciplines and medical specialties. In addition, the 2001 ADA clinical practice recommendations were distributed to all providers and placed in binders in the exam rooms. Diabetes treatment flowcharts based on the ADA guidelines were also placed in exam rooms.

### Measures
Primary measures were hemoglobin A1c (HbA1c) values and

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**Table 1. Structure of Diabetes Education Classes**

<table>
<thead>
<tr>
<th>Profession</th>
<th>Topic</th>
<th>Time</th>
<th>Handouts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse</td>
<td>Overview of diabetes and complications</td>
<td>60 min</td>
<td>Presentation slides</td>
</tr>
<tr>
<td></td>
<td>Foot care</td>
<td>20 min</td>
<td></td>
</tr>
<tr>
<td>Dietitian</td>
<td>Meal planning, portions, food groups</td>
<td>120 min</td>
<td>Previous lab measures including lipid panel and HbA1c, Nutrition assessment</td>
</tr>
<tr>
<td></td>
<td>Laboratory measures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical pharmacist</td>
<td>Medications and monitoring</td>
<td>70 min</td>
<td>Diabetes day planner, blood glucose meter and supplies, and presentation slides</td>
</tr>
<tr>
<td>Dentist</td>
<td>Oral health and periodontal disease</td>
<td>20 min</td>
<td>Pamphlet on periodontal disease</td>
</tr>
<tr>
<td>Optometrist</td>
<td>Diabetic retinopathy and other eye health issues</td>
<td>20 min</td>
<td>Diabetic retinopathy booklet</td>
</tr>
<tr>
<td>Exercise physiologist</td>
<td>Starting an exercise program</td>
<td>20 min</td>
<td>Contact information for the health and wellness center</td>
</tr>
<tr>
<td>Psychologist</td>
<td>Dealing with diabetes and stress management</td>
<td>30 min</td>
<td>Contact information for mental health counseling</td>
</tr>
</tbody>
</table>

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**Figure 1:** Diabetes Care Record

**Figure 2:** Diabetes treatment flowcharts based on the ADA guidelines
**Figure 1. Diabetes care record.**
low-density lipoprotein cholesterol (LDL) and blood pressure levels (the most recent measure in the medical record in the past 12 months). Secondary measures were frequency of annual recommended screening (foot and eye exams, microalbuminuria test, measurement of serum creatinine) and utilization of selected drug therapies (aspirin, angiotensin-converting enzyme inhibitors [ACE-I], antidepressants). The team considered all patients eligible for therapy with ACE-I and aspirin unless specifically contraindicated. The drug list for each patient was generated using the pharmacy computer system and included drug name, strength, dosing, quantity, refills, provider, and date filled. Smoking cessation counseling was defined as documentation of enrollment in the class; attendance was not verified.

For the baseline review (August 2000), we used the Composite Healthcare Computer System (CHCS), the pharmacy computer system containing prescription, lab, appointment, and other medical record data, to generate a report of all patients seeing a provider and taking an oral diabetic agent or insulin within the previous 6 months. Of the 354 patients identified, 118 were randomly selected for chart review using a random numbers table. Patients were excluded if their records were not available for review or if the patient had expired, had not seen a primary provider within the 6 months prior to the review, or had not been an established patient for at least 6 months. 100 of the 118 patients met inclusion criteria.

For the postintervention review (August 2001), the entire list of diabetes patients was again generated. 316 patients were identified using the International Classification of Diseases, 9th Revision (ICD-9) code 250.xx (diabetes mellitus). The ICD-9 method allowed the researchers access to diabetic patients who may not be prescribed medication, unlike the CHCS query done previously. All patients receiving team care (operationally defined as those completing at least 6 hours of diabetes education classes and seen at least twice by the pharmacist) were designated the team group (n = 57). Sixty of the remaining 259 charts were randomly selected for chart review. After exclusion criteria were applied, there were 54 patients, which we designated the PCP group.

Data was gathered by a pharmacy student and one of the authors (JRS) from individual medical records using a standard data collection tool developed for the evaluation. All recorded information was subsequently entered into a Microsoft Access database for analysis. Statistical significance for continuous variables was determined using independent t tests with an alpha of 0.05. Chi-square tests were used to compare nominal data and the number of patients achieving ADA goals between groups. Patients with missing data were removed from the analysis of that data but not from other analyses where data was present.

Results
Patient demographics are shown in Table 2. Females in the PCP group were significantly older than those in the team group (55.9 versus 50.4 years, P = 0.038). There were no other significant differences in demographics. The most common comorbidity was hypertension (Table 2). A patient was considered to have hypertension if the diagnosis was recorded on the chart, if the current blood pressure reading was 130/80 mm Hg or greater, or if the patient was on an anti-hypertensive. Other common diagnoses were coronary artery disease, postcoronary event, tobacco use, nephropathy, and depression.

HbA1c values, LDL levels, and blood pressure levels are shown in Table 3. The mean HbA1c value was significantly lower among the postintervention patients as compared with baseline. Moreover, the mean HbA1c value for the team group was significantly lower than for the PCP group. Of the patients with documented HbA1c values, 41.2% of PCP patients and 61.8% of team patients met the HbA1c goal of less than 7% (P = 0.034). Fewer patients in the team group had an HbA1c of 8% or greater as compared with the PCP group (P = 0.014).

More postintervention patients than baseline patients had a documented lipid measurement. The difference in mean LDL between baseline and postintervention patients and between PCP and team groups was not statistically significant. The proportion of evaluated patients meeting the LDL goal (< 100 mg/dL) was higher for the postintervention and PCP groups, although the differences were not significant. Of the postintervention patients not meeting the LDL goal, the 27 in the PCP group had a mean LDL of 136.1 mg/dL ± 27.8 and the 30 in the team group had a mean LDL of 134.2 mg/dL ± 44.2. Only 45.9% of postintervention patients were taking a cholesterol-reducing agent: 25 (46.3%) in the PCP group and 44.2. Only 45.9% of postintervention patients were taking a cholesterol-reducing agent: 25 (46.3%) in the PCP group and 26 (45.6%) in the team group.

Even with the lower goal blood pressure (< 130/80 versus < 130/85 mm Hg), significantly more patients postintervention were at goal as compared with baseline (P = 0.009). Control did not differ significantly by provider. Mean systolic blood pressure and diastolic blood pressure did not differ significantly between baseline and postintervention; however, mean diastolic blood pressure was significantly lower for the PCP group (Table 3).

There was no increase in adherence to ADA-recommended testing following the intervention. As shown in Table 4, a significantly higher percentage of baseline patients were tested for microalbuminuria. The increase in annual eye exams was not statistically significant. There was no difference in the proportion of patients receiving foot exams and serum creatinine measurements. The differences between PCP and team groups were significant only for documented annual foot exams, with more PCP patients receiving them.
Diabetes Follow-up

Subjective: Pt presents today for a follow-up of their diabetes and __________________________________________________

Current Meds:

Review of Systems
Hypoglycemia sx / Leg or Foot pain / Visual changes
Weight gain or loss / Diarrhea / GERD sx / PND
Chest pain / SOB / Skin problems / new DOE
Orthopnea / Claudication / Myalgias

Blood Sugar Log:
AM _____ to _____; noon _____ to _____
PM _____ to _____; hs _____ to _____

Blood Pressure Log:

Comorbidities: ❑ None
Obesity / CAD / h/o MI / HTN / Thyroid dz
Hyperlipidemia / PVD / GERD
Neuropathy / Nephropathy / Retinopathy
Other:_________________________________

Smokes: ______ ppd for ______ yrs = ______ ppyr history
(Quit smoking ______/______)

Physical Exam:
Vitals: BP______/______ HR________ WT________ AGE________
Gen: NAD / healthy appearing / obese _____ male / female
HEENT: NC / PERRLA / EOMI / C:D NL bilat / lens NL bilat / pharynx clear
CV: RRR W/O M/G/R; PMI NL; no JVD
   Neck: no bruits / NL thyroid
Lungs: CTA bilat w/o W/R/R
   Abdomen: NT/ND / no HSM / no mass / +BS / no ABD bruits / obese
Ext: no C / E / E
   Pulses: DP 0/1+/2+ on R / L / B; Fem 0/1+/2+ on R / L / B
Feet: normal skin / nails / sensory exam

Assessment:
1. Type I / II DM; good / mod / poor control
2. PPID
3. 
4. 
5. 
6. 
7. 

Assessment:

Plan:
❑ Refill current meds for _____ months
❑ Change / add Rx _______________________________
   Labs needed in _____ mos or now: glyc hgb / microalb
   24hr urine for prot & cr / chem 7 / lipids / LFTs / TSH
   Other _______________________________
❑ Check BS log qam / q noon / qpm / qhs _____ days/wk
❑ Stressed keeping BS log / BP log and bring it each visit
❑ Diabetic flow sheet updated
❑ Check EKG; Schedule GXT – Y / N
❑ Referrals: _______________________________
   Send to diabetes education class
❑ Encouraged/counseled: exercise / wt loss / foot care diet / smoking cessation
❑ Follow up in _____ wks / months or sooner prn
❑ Immunizations due: _______________________________

Patients Name (last, first, middle initial)    Sex
Relationship to Sponsor    Status    Rank/Grade
Sponsors Name    Organization
Depart/Service    SSN    DOB

Figure 2. Diabetes treatment flowchart.
With regard to drug therapy, documented aspirin use was significantly higher postintervention ($P = 0.02$) (Table 5). In addition, more team patients were taking aspirin compared with team patients. No patient had a documented allergy to aspirin during the postintervention. ACE-I use was similar across all groups. Of the 15 patients with a diagnosis of nephropathy, 3 (50%) PCP group patients and 8 (88.9%) team patients were receiving an ACE-I. Team patients were more likely to receive smoking cessation counseling.

**Discussion**

Observational studies and prospective clinical trials directly link a reduction in blood glucose with a reduction in diabetic complications [1,2,11]. We saw statistically significant improvement in HbA$_1c$ values among diabetes patients following implementation of multiple interventions in our ambulatory setting. The change was smaller than that seen in other studies [12–16]; this may be attributable in part to our low baseline HbA$_1c$ levels. Team patients achieved significantly lower mean

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**Table 2. Patient Characteristics**

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Postintervention</th>
<th>$P$ Value</th>
<th>PCP</th>
<th>Team</th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patients</td>
<td>100</td>
<td>111</td>
<td></td>
<td>54</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>Mean ± SD age, yr</td>
<td>55.7 ± 13.0</td>
<td>55.3 ± 9.7</td>
<td>0.93</td>
<td>56.9 ± 9.34</td>
<td>53.8 ± 9.85</td>
<td>0.088</td>
</tr>
<tr>
<td>Gender, n</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>52 (52%)</td>
<td>55 (49.5%)</td>
<td>0.722</td>
<td>26 (48%)</td>
<td>29 (51%)</td>
<td>0.774</td>
</tr>
<tr>
<td>Male</td>
<td>48 (48%)</td>
<td>56 (50.5%)</td>
<td>28 (52%)</td>
<td>28 (49%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comorbid diagnoses, n</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>92 (92%)</td>
<td>109 (98.2%)</td>
<td>53 (98.1%)</td>
<td>56 (98.2%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAD</td>
<td>42 (42%)</td>
<td>59 (53.1%)</td>
<td>33 (61.1%)</td>
<td>26 (45.6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postcoronary event</td>
<td>18 (18%)</td>
<td>18 (16.2%)</td>
<td>9 (16.7%)</td>
<td>9 (15.8%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tobacco use</td>
<td>11 (11%)</td>
<td>20 (18.0%)</td>
<td>12 (22.2%)</td>
<td>8 (14.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nephropathy</td>
<td>6 (6%)</td>
<td>15 (13.5%)</td>
<td>6 (11.1%)</td>
<td>9 (15.8%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>7 (7%)</td>
<td>11 (9.9%)</td>
<td>8 (14.8%)</td>
<td>3 (5.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total diagnoses*</td>
<td>177</td>
<td>211</td>
<td></td>
<td>110</td>
<td>101</td>
<td></td>
</tr>
<tr>
<td>Mean ± SD no. of</td>
<td>1.86 ± 1.06</td>
<td>2.01 ± 1.02</td>
<td></td>
<td>2.12 ± 1.13</td>
<td>1.91 ± 0.90</td>
<td></td>
</tr>
</tbody>
</table>

CAD = coronary artery disease.

*Total diagnoses include those listed plus retinopathy, neuropathy, and peripheral vascular disease. No significant differences were found between baseline and postintervention and PCP and team groups.

**Table 3. Primary Laboratory Measures**

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Postintervention</th>
<th>$P$ Value</th>
<th>PCP</th>
<th>Team</th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patients</td>
<td>100</td>
<td>111</td>
<td></td>
<td>54</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>HbA$_1c$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measured past 12 mo, n</td>
<td>83 (83%)</td>
<td>106 (95%)</td>
<td>0.003</td>
<td>51 (94.4%)</td>
<td>55 (96.5%)</td>
<td>0.603</td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>7.85 ± 1.60</td>
<td>7.25 ± 1.32</td>
<td>0.006</td>
<td>7.61 ± 1.31</td>
<td>6.92 ± 1.26</td>
<td>0.007</td>
</tr>
<tr>
<td>&lt; 7%, n</td>
<td>42 (50.6%)</td>
<td>55 (51.9%)</td>
<td>0.479</td>
<td>21 (41.2%)</td>
<td>34 (61.8%)</td>
<td>0.034</td>
</tr>
<tr>
<td>≥ 8%, n</td>
<td>29 (34.9%)</td>
<td>19 (17.9%)</td>
<td>0.008</td>
<td>14 (27.5%)</td>
<td>5 (9.1%)</td>
<td>0.014</td>
</tr>
<tr>
<td>Lipids</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measured past 12 mo, n</td>
<td>66 (66%)</td>
<td>93 (83.7%)</td>
<td>0.003</td>
<td>47 (87.0%)</td>
<td>46 (80.7%)</td>
<td>0.365</td>
</tr>
<tr>
<td>Mean ± SD LDL, mg/dL</td>
<td>119.1 ± 33.6</td>
<td>114.2 ± 40.3</td>
<td>0.41</td>
<td>112.4 ± 36.3</td>
<td>116.1 ± 44.4</td>
<td>0.66</td>
</tr>
<tr>
<td>LDL &lt; 100 mg/dL</td>
<td>19 (28.8%)</td>
<td>36 (38.7%)</td>
<td>0.195</td>
<td>20 (42.6%)</td>
<td>16 (34.8%)</td>
<td>0.442</td>
</tr>
<tr>
<td>Blood pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At goal, n*</td>
<td>14 (15.2%)</td>
<td>32 (29.4%)</td>
<td>0.009</td>
<td>13 (24.1%)</td>
<td>19 (33.9%)</td>
<td>0.282</td>
</tr>
<tr>
<td>Mean ± SD systolic</td>
<td>141.2 ± 19.2</td>
<td>137.5 ± 16.0</td>
<td>0.14</td>
<td>138.3 ± 14.9</td>
<td>136.8 ± 17.1</td>
<td>0.64</td>
</tr>
<tr>
<td>Mean ± SD diastolic</td>
<td>79.2 ± 11.8</td>
<td>78.9 ± 10.1</td>
<td>0.84</td>
<td>76.9 ± 9.8</td>
<td>80.8 ± 10.2</td>
<td>0.043</td>
</tr>
</tbody>
</table>

*< 130/85 mm Hg for baseline review and < 130/80 mm Hg for postintervention review.
HbA1c concentrations and were more likely to reach goal (<7%) as compared with PCP patients, a finding consistent with other studies that have looked at team care for diabetes [12–16].

Our approach incorporated multiple methods shown to be successful at improving HbA1c values, such as physician education [17], adoption of the ADA clinical practice recommendations or achievable benchmarks [17,18], incorporation of flowcharts or reminders [18], and development of a specialized diabetes care team [12–16]. Like other studies [7,10], our study suggests that multiple interventions are needed. However, as in other trials, a number of patients remained uncontrolled, suggesting that the optimal approach for improving HbA1c remains elusive.

Regardless of the high baseline rate of annual HbA1c testing, which exceeded the 1998 estimated national annual testing rate of 24% and the Healthy People 2010 objective of 50% [19], the postintervention period saw a significant increase in the proportion of patients receiving yearly HbA1c determinations. Referral to other health care providers, though, did not impact yearly HbA1c testing, which may be explained by the high proportion of patients already receiving testing and the inability of team members to order labs.

Although annual lipoprotein measurement increased significantly postintervention, the mean LDL did not. This may have been due to the low mean LDL (119.1 mg/dL) at baseline. In addition, team pharmacists could increase medication doses but could not independently add therapies, although they could leave recommendations on the chart and schedule patient follow-up with the PCP; thus, their potential impact on lipid management was limited. Although the proportion of patients reaching the LDL goal increased, surpassing the national estimate of 33.3% [20], this finding was not statistically significant. Factors contributing to the poor rate of control may have included noncompliance and controversy over the benefits of treating to target. In addition, the facility’s preferred statin was abruptly withdrawn from the market during the implementation period. The restricted formulary left providers with only 1 choice of statin, and many patients were likely undergoing changes in therapy due to the change in insurance coverage during the study while others may have remained untreated secondary to a previous failure or intolerance of the available statin.

Initially, the proportion of controlled hypertensive diabetes patients in the clinic barely exceeded the national average of 12% [21]. We did not see a significant reduction in mean systolic or diastolic blood pressure, yet the proportion of patients meeting the blood pressure goal of 130/80 mm Hg or lower increased significantly. Referral to the team did not improve blood pressure control, and diastolic blood pressure was noted to be significantly higher for team patients. It is difficult to explain this finding, but it should be remembered that team members had only a limited impact on drug therapy. Initiation of new medications by team members, if allowed, might have led to further improvements in these values.

<table>
<thead>
<tr>
<th>Table 4. Adherence to Recommended Annual Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patients</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Eye exam, n</td>
</tr>
<tr>
<td>Foot exam, n</td>
</tr>
<tr>
<td>Microalbuminuria test, n</td>
</tr>
<tr>
<td>Serum creatinine level, n</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 5. Use of Drug Therapies and Other Recommended Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patients</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>ACE-I use overall, n</td>
</tr>
<tr>
<td>ACE-I use in patients with nephropathy, n</td>
</tr>
<tr>
<td>Aspirin use, n</td>
</tr>
<tr>
<td>Antidepressant use, n</td>
</tr>
<tr>
<td>Tobacco cessation program, n</td>
</tr>
<tr>
<td>Glucose self-monitoring, n</td>
</tr>
</tbody>
</table>

*In patients with a documented diagnosis of depression.
†Shows percentage of smokers who enrolled.
The rate of foot exams did not change significantly, but the results indicate the team patients were less likely to receive an annual foot exam. The proportion of team patients receiving foot exams is likely underestimated due to a lack of documentation as all patients attending the first diabetes education class received a foot exam. Thus, the expected rate of foot exams for the team group should be 100%.

The baseline rate of preventative treatment with ACE-I was relatively high and did not change postintervention. At the time of our study, ACE-I were considered the drugs of choice for patients with microalbuminuria or clinical albuminuria because of their beneficial effects on renal function beyond simple blood pressure control [22,23]. However, angiotensin-II receptor antagonists also slow progression of nephropathy in hypertensive type 2 diabetics and are now considered therapeutic options for type 2 diabetes patients with microalbuminuria or clinical albuminuria [5,24,25].

Although self-monitoring of blood glucose did not change after the interventions, team patients were more likely to self-monitor, which may have contributed to the improved glucose control in this group. Although statistical analysis was not performed, the team appeared to be more effective at enrolling patients into smoking cessation programs; however, this success may not be reliable for other practice sites where patients have to purchase cessation aids.

There are limitations to our findings. This research was conducted at a military facility, and the results may not be generalizable to other practice environments. Certain interventions, such as the flowchart and chart stickers, could have been used by PCPs, thus diluting the comparison between PCP and team groups. Not all confounders could be controlled for because data were collected retrospectively. Additional limitations included the inability to assess patient adherence to laboratory visits, prescribed drug therapies, or lifestyle changes; the effects of recent increases in dosages or additions to the therapeutic regimen; patient factors contributing to alterations in normal practice patterns; the occurrence of acute care issues precluding the assessment of diabetes at any given visit; care provided by non-facility providers or specialists; and lack of ability to assess changes in quality of life, morbidity, and mortality from the data gathered.

Conclusion

The results of this evaluation suggest adherence to ADA clinical practice recommendations varies by provider, and multiple interventions may help to improve adherence to these recommendations. Our findings include improved glycemic and blood pressure control and improved rates of HbA1c, lipid, and microalbuminuria testing. Patients managed by a team of health care professionals may be more likely to reach clinical targets as compared with those managed by a single provider. Adherence to goals in this practice site was consistently higher than national estimates, but opportunity for improvement in the delivery of diabetes care services for this patient population remains.

Note: This work is that of the authors and should not be considered an official expression of the Department of Defense or the United States Air Force.

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