Cardiovascular Disease Prevention Practices by U.S. Physicians for Patients with Diabetes

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OBJECTIVE: **Cardiovascular diseases account for the majority of morbidity and mortality in patients with type 2 diabetes mellitus. We describe patterns of cardiovascular disease primary prevention practices used for patients with diabetes by U.S. office-based physicians.**

MEASUREMENTS AND MAIN RESULTS: **We analyzed a representative sample of 14,038 visits from the 1995 and 1996 National Ambulatory Medical Care Surveys (NAMCS), including 1,489 visits by patients with diabetes. Physicians completed visit forms describing diagnoses, demographics, services provided, and current medications. Diabetes was defined by diagnostic codes; patients with ischemic heart disease or younger than 30 years were excluded. We estimated national visit volumes by extrapolation using NAMCS sampling weights. Independent determinants of prevention practices were evaluated using multiple logistic regression. Actual visits sampled translated into an estimated 407 million office visits in 1995 and 1996, of which 44.8 million (11%) were by patients with diabetes. Overall, patients with diabetes received more cardiovascular disease prevention services than patients without diabetes, including cholesterol reduction (8% vs 5%, $P < .001$) and exercise counseling (22% vs 13%, $P < .001$), blood pressure measurement (82% vs 72%, $P < .001$), and aspirin prescription (5% vs 2%, $P < .001$). Patients with diabetes and hyperlipidemia were more likely to receive lipid-lowering medications than patients without these diagnoses (67% vs 51%, $P = .007$), but those who had diabetes and hypertension or who smoked were no more likely than those without to receive antihypertensive medications or smoking cessation counseling, respectively. These effects persisted in multiple logistic regression analyses controlling for potential confounders.**

CONCLUSIONS: **Patients with diabetes visiting U.S. physicians in 1995 and 1996 received somewhat more cardiovascular disease prevention services than patients without diabetes. Absolute rates of services, however, remained lower than desired based on national recommendations. Current evidence suggests that wider implementation of these recommendations can be expected to reduce the burden of cardiovascular disease in patients with diabetes.**

KEY WORDS: **cardiovascular disease; type 2 diabetes; prevention.**

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Diabetes mellitus is a common chronic condition affecting almost 8% of the U.S. population between the ages of 20 and 74 years.[1] Care for diabetes is the fourth most common reason for ambulatory physician visits,[2] the majority of which are to office-based primary care physicians.[3] Well over 90% of people with diabetes have type 2 diabetes mellitus.[2,4] Atherosclerotic cardiovascular disease (CVD) accounts for the majority of morbidity[5] and mortality[6,7] in people with type 2 diabetes. Diabetes and its CVD complications are costly in economic terms as well as in human suffering. Estimated health care expenditures for diagnosed diabetes total nearly $100 billion.[8,9] At least 26% of costs attributable to diabetes in one managed care organization were due to CVD complications.[10]

Clinical management of diabetes has traditionally focused on glycemic control. However, observational associations between blood glucose levels and CVD complications have been inconsistent,[11,12] and randomized, controlled trials of intensive glycemic control in patients with type 2 diabetes have not shown significant reductions in CVD event rates.[13–15] In contrast, clinical trials subgroup analyses of patients with type 2 diabetes have consistently demonstrated reductions in CVD event rates with intensive management of hyperlipidemia[16–20] and hypertension,[21–26] and with use of aspirin prophylaxis.[24,27,28] Cigarette smoking also has a pernicious effect among those with diabetes.[29] While interventions to improve these CVD risk factors have been widely recommended,[30–35] little is known about physician practices related to CVD risk factor modification among people with diabetes. In this report, we analyzed data from the 1992, 1995, and 1996 National Ambulatory Medical Care Surveys (NAMCS) to assess the prevalence, determinants, and trends over time in primary CVD prevention practices provided to patients with diabetes in the United States.

METHODS

We analyzed data from the NAMCS for 1992, 1995, and 1996.[36–38] Conducted by the National Center for Health Statistics (NCHS), these surveys assess the practices of U.S. office-based physicians. The American Medical Association and American Osteopathic Association master lists of all U.S patient care physicians were used to select a random physician sample stratified by geographic area and specialty. Annual participation rates among eligible physicians averaged 72%. Patient visits during a randomly selected week were sampled for each participating physician in each year. For the years we analyzed, the survey included 34,606 (1992), 36,875 (1995),

and 29,805 (1996) outpatient visits to 1,558 (1992), 1,883 (1995), and 1,500 (1996) physicians.

Participating physicians completed NAMCS encounter forms detailing the specific clinical services provided, new and ongoing medications, and patient demographics and diagnoses. For each recorded visit the NCHS provided a visit weight calculated from the physician and visit-sampling rates, adjusted for nonresponse. Statistical aggregation using these visit weights allows extrapolation so that practice patterns and the volume of patient visits can be estimated at a national level. We modified these weights according to Potthoff et al.[39] To derive effective sample sizes for use in statistical testing, we used NCHS relative standard errors to estimate the 95% confidence intervals for these national estimates.[36–38] Validation studies performed in earlier years confirm the accuracy of the information obtained.[40] Missing data were limited to approximately 5% of most data fields. The NAMCS is a cross-sectional study and does not allow specific patients to be followed longitudinally. The unit of analysis is the patient visit, rather than the patient. The data do not include outpatient care provided by hospital outpatient departments, some health centers, emergency departments, or by nonphysician providers.

Our primary analytic goal was to compare rates of CVD prevention services provided to patients with diabetes and to those without diabetes. We identified visits by patients with diabetes mellitus by an *International Classification of Diseases, Math Revisions, Clinical Modification* (*ICD-9-CM*) diagnostic code of 250, by a NAMCS-specific "reason for visit code" for diabetes, by a check-off indicator for diabetes (in 1995 and 1996), or by the report of oral hypoglycemic or insulin therapy. We excluded visits by patients with reported coronary heart disease and visits by patients under the age of 30 years in order to assess practices related to primary CVD prevention for those most likely to have type 2 diabetes or type 1 diabetes of long duration. Patients with diabetes were classified into three groups according to whether they were treated with insulin, with an oral hypoglycemic agent alone, or with neither of these medications; the latter we defined as diet-treated diabetes. We further limited our analysis to visits made to primary care physicians, endocrinologists, and cardiologists, the specialties most likely to be expected to provide diabetes prevention services. Using these criteria, our analysis for 1995 and 1996 included 14,038 visits: 1,489 by patients with diabetes and 12,549 by patients without diabetes.

Our principal outcome measures were the provision of several specific ambulatory services related to CVD prevention. We assessed whether a variety of counseling and diagnostic testing services were performed, and whether patients were reported to be taking specific classes of medications. We analyzed physician practices as they applied to all patient visits in aggregate and to clinical subsets of patients for whom specific services would be most applicable. For all patients we examined exercise counseling, cholesterol reduction counseling, weight reduction counseling, cholesterol testing, blood pressure measurement, and the report of aspirin prescription. We also examined the following subsets: patients with hypertension (blood pressure measurement, angiotensin-converting enzyme [ACE] inhibitor use, β-blocker use, and thiazide diuretic use, and use of any blood pressure medication), patients with hyperlipidemia (cholesterol counseling and lipid-lowering medication use), cigarette smokers (smoking cessation counseling), and patients with obesity (weight reduction advice, exercise counseling, and obesity medications). For each service we used the χ^2 test to evaluate whether the three groups of patients with diabetes differed statistically from patients without diabetes.[41]

We further defined clinical, demographic, and physician characteristics hypothesized to influence the provision of CVD prevention services, including the presence of hypertension, smoking, obesity, and hyperlipidemia; patient age, race, and gender; geographic region of the country (four regions), whether the patient resided in a metropolitan statistical area (yes or no), and physician specialty. We used these characteristics both to describe patients with diabetes and to account for their potentially confounding effects in comparisons between patients with and patients without diabetes. We evaluated independent predictors of CVD services with a series of multiple logistic regression models assessing the effect of diabetes versus no diabetes on the likelihood of services being provided at a specific patient visit, controlling for effects of potentially confounding variables.[42] We ran logistic regression models using generalized estimating equations; this method accounts for potential correlation between observations (patient visits) recorded by the same physician.[43] Effective sample size weights were also included in regression models to further account for the complex NAMCS sampling design. We tested for statistical interactions between major demographic factors and provision of prevention services by introducing first-order interaction terms (e.g., race × diabetes) into regression models.

We also used data from 1992 to gauge whether changes have occurred since then in CVD prevention practices for patients with or patients without diabetes. We calculated the difference in the percentage of visits in which specific services were provided between 1992 and 1995–1996, assessing statistical differences with the χ^2 test for trend. We used SAS for all analyses,[44] and defined statistical significance as a two-tailed $P < .05$.

RESULTS

In 1995 and 1996 actual visits translated into an estimated 407 million (95% confidence interval [CI], 371 to 443 million) visits to office-based primary care physicians, endocrinologists, and cardiologists in the United States by patients over 30 years of age not known to have coronary heart disease. Of these, 44.8 million (11%) were

by patients with diabetes mellitus. Patient characteristics are displayed in Table 1. Among patients with diabetes, 16% were treated with insulin, 35% with oral hypoglycemic medications alone, and 49% with no specific hypoglycemic medication. Patients with diabetes were more likely to be seen by endocrinologists and less likely to be seen by family and general practitioners compared with patients without diabetes. Patients with diabetes were older, and a greater proportion were not white, compared with those without diabetes. Hyperlipidemia (9%), hypertension (49%), and obesity (21%) were more common among patients with diabetes than among those without diabetes, but similar proportions of patients were cigarette smokers (11%).

The presence of diabetes made it moderately more likely for patients to receive some CVD prevention services during an office visit (Table 2). Diabetic patients were about twice as likely to receive counseling about exercise (21.7% of visits by diabetes patients vs 12.8% of visits by patients without diabetes, $P = .001$) and weight reduction (16.6% vs 7.1%, $P = .001$). Physicians were more likely to measure blood pressure for patients with diabetes compared with those without diabetes (81.9% vs 72.3%, $P = .001$). Among patients with diabetes, those treated with oral hypoglycemic medications were more likely to receive these services than were those treated with insulin or diet only. Although cholesterol advice (8.1 vs 4.7%, $P = .001$) and aspirin use (4.8% vs 2.3%, $P = .001$) were more likely to occur among patients with diabetes, these differences were limited to medication-treated patients with diabetes. The likelihood of cholesterol testing among patients with diabetes (8.8% vs 7.4%, $P = .001$) was not significantly different from that among patients without diabetes.

Among patients with hypertension, blood pressure measurement was no more likely to occur among all patients with diabetes than among those without diabetes (86.4% vs 83.7%, $P = .1$), although blood pressure was more likely to be measured among the subgroup treated with oral hypoglycemic medications (Table 2). Overall, prescription of medication for hypertension was equally likely among patients with and patients without diabetes (52.7% vs 51.6%, $P = .7$), but use of antihypertensive medications was more common among medication-treated diabetic patients and less likely among patients treated with diet only. The classes of medications used to treat hypertension differed between patients with and patients without diabetes: hypertensive patients with diabetes were more likely to be taking ACE inhibitors (22.8% vs 18.2%, $P = .02$), but less likely to be taking β-blockers (9.3% vs 12.6%, $P = .04$) and thiazide diuretics (10.6% vs 14.3%, $P = .03$).

For patients with hyperlipidemia, there was no difference in the provision of cholesterol counseling between those with and those without diabetes (33.7% vs 36.5%, $P = .6$; Table 2). The use of lipid-lowering medications was more likely among patients with diabetes (66.9% vs 51.3%, $P = .007$), but was most likely among insulin-treated diabetes patients. For patients smoking cigarettes, there were no differences between those with and those

Table 1. Characteristics of Office Visits by Patients With and Patients Without Diabetes, National Ambulatory Medical Care Surveys (NAMCS) 1995–1996

Characteristic	Patients Without Diabetes	Patients with Diabetes		
		Without Reported Hypoglycemic Medications	Treated with Oral Hypoglycemic Medications	Treated with Insulin
NAMCS observations	12,549	750	499	240
Total U.S. visits (in millions)	362.1	21.9	15.7	7.2
Percentage of all visits	89.0	5.4	3.9	1.8
Physician specialty, %				
Endocrinology	0.8	3.4*	4.2*	10.6*
Cardiology	3.3	4.0	2.7	4.9
Family practice/general practice	57.5	51.2†	50.4†	41.2*
General internal medicine	38.4	41.4	42.6	43.3
Female, %	60.5	60.6	55.1‡	60.3
Age, %				
30–49 y	44.2	20.8*	21.9*	22.4*
50–64 y	24.3	29.0‡	32.9*	31.9*
65–74 y	17.3	31.5*	23.8†	25.0‡
75+ y	14.4	18.8†	21.4*	20.6‡
Nonwhite, %	15.0	21.9*	20.2†	26.3*
Smoker, %	12.7	12.2	9.0‡	10.1
Obesity, %	10.6	18.2*	24.9*	19.2*
Hyperlipidemia, %	5.7	7.3	10.2*	9.1
Hypertension, %	27.5	47.8*	48.3*	51.5*

*$P < .001$, compared with patients without diabetes.
†$.001 < P < .01$.
‡$.01 < P < .05$.

Table 2. Cardiovascular Disease Prevention Services Among Patients With and Without Diabetes Mellitus, National Ambulatory Medical Care Surveys (NAMCS) 1995–1996

Cardiovascular Disease Prevention Service	Patients Without Diabetes	Patients with Diabetes		
		Without Reported Hypoglycemic Medications	Treated with Oral Hypoglycemic Medications	Treated with Insulin
Of all visits, percentage receiving				
Exercise counseling	12.8	16.2*	30.2†	19.9‡
Cholesterol advice	4.7	5.8	12.8†	4.8
Cholesterol test	7.4	8.6	9.6	7.4
Weight reduction advice	7.1	12.5†	24.0†	13.0‡
Blood pressure measurement	72.3	77.4*	86.8†	85.1†
Aspirin	2.3	2.7	6.6†	7.2†
Of visits by patients with hypertension, percentage receiving				
Blood pressure measurement	83.7	83.8	90.9*	84.4
Blood pressure medications	51.6	36.5†	69.6†	64.1*
Angiotensin-converting enzyme inhibitors	18.2	13.1	34.4†	23.1
β-Blockers	12.6	9.0	8.8	11.1
Thiazide diuretics	14.3	8.6*	14.3	8.8
Of visits by patients with hyperlipidemia, percentage receiving				
Cholesterol advice	36.5	28.2	45.9	17.1
Lipid-lowering medications	51.3	63.8	63.6	82.5*
Of visits by patients who are smokers, percentage receiving smoking counseling	26.9	25.8	21.6	19.8
Of visits by patients with obesity, percentage receiving				
Weight reduction counseling	38.3	43.2	57.0†	41.2
Exercise counseling	33.4	34.5	49.8‡	39.0
Obesity medications	5.9	0.3*	0.5*	0.8

*$.01 < P < .05$, compared with patients without diabetes.
†$P < .001$.
‡$.001 < P < .01$.

without diabetes (23.6% vs 26.9%, $P = .5$) in the likelihood of receiving smoking cessation counseling.

Among patients reported to be obese, weight reduction advice (48.7% vs 38.3%, $P = .006$) and exercise counseling (41.6% vs 33.4%, $P = .03$) were more likely for patients with diabetes (Table 2). These differences were greatest for diabetic patients treated with oral agents. Pharmacologic treatment of obesity was rare, but was more than 10 times less common in patients with diabetes than in those without diabetes (0.5% vs 5.9%, $P = .001$).

After adjustment for potential confounders, patients with diabetes remained generally more likely to receive services compared with patients without diabetes (Table 3). The magnitude of these differences, however, was often modest. For all patients, those with diabetes were 12% to 98% more likely to receive exercise counseling, weight reduction advice, blood pressure measurement, cholesterol counseling, and aspirin therapy. The presence of diabetes did not affect the likelihood of cholesterol testing. For patients with hypertension, there was no independent effect of diabetes on blood pressure measurement or the overall use of blood pressure medications. Significant differences in the selection of medications persisted, with diabetic patients more likely to receive ACE inhibitors and less likely to receive thiazide diuretics. Patients with diabetes and hyperlipidemia were twice as likely to be taking lipid-lowering medications as nondiabetic patients, but were no more likely to be counseled about cholesterol reduction. Smokers with diabetes were equally likely to receive smoking cessation advice as those without diabetes. Obese patients were just over 50% more likely to receive exercise counseling and weight reduction counseling if they had diabetes. Obese patients with diabetes, however, remained much less likely to be taking medications specifically intended to treat obesity.

Several other factors also influenced the provision of CVD prevention services independent of diabetes and other characteristics. Younger patients and male patients were generally more likely to receive prevention services. Patients residing in metropolitan areas tended to be less likely to receive services. Patients with hypertension, hyperlipidemia, or obesity were in general more likely to receive most services. Race, region of the country, and physician

Table 3. Independent Impact of Diabetes on Cardiovascular Disease Prevention Practices, National Ambulatory Medical Care Surveys (NAMCS) 1995–1996

Dependent Variable	Adjusted Odds Ratio (95% CI) Diabetes Versus No Diabetes*
Total population	
Exercise counseling	1.61 (1.37 to 1.90)
Weight reduction advice	1.98 (1.59 to 2.45)
Blood pressure measurement	1.12 (1.04 to 1.28)
Aspirin	1.46 (1.03 to 2.07)
Cholesterol advice	1.28 (0.99 to 1.66)
Cholesterol test	0.90 (0.71 to 1.15)
Patients with hypertension	
Blood pressure measurement	1.07 (0.84 to 1.37)
Blood pressure medications	1.04 (0.85 to 1.27)
Angiotensin-converting enzyme inhibitors	1.36 (1.07 to 1.74)
β-Blockers	0.71 (0.51 to 0.99)
Thiazide diuretics	0.70 (0.51 to 0.96)
Patients with hyperlipidemia	
Cholesterol advice	0.96 (0.59 to 1.56)
Lipid-lowering medications	1.87 (1.12 to 3.11)
Patients who are smokers	
Smoking counseling	0.81 (0.50 to 1.29)
Patients with obesity	
Weight reduction counseling	1.53 (1.12 to 2.11)
Exercise counseling	1.52 (1.09 to 2.10)
Obesity medications	0.11 (0.02 to 0.68)

**Model included the additional independent variables of age group, physician speciality, gender, race, region, metropolitan statistical area, and clinical characteristics including hypertension, obesity, smoking status, and hyperlipidemia. CI indicates confidence interval.*

Table 4. Temporal Differences in Cardiovascular Prevention Services between 1992 and 1995–1996 National Ambulatory Medical Care Surveys (NAMCS)

Cardiovascular Disease Prevention Service	Patients Without Diabetes	Patients With Diabetes
Of all visits, percentage difference		
Exercise counseling	2.8*	−1.4
Cholesterol advice	−1.3†	−4.4‡
Cholesterol test	1.3‡	−1.1
Weight reduction advice	−0.1	−4.9‡
Blood pressure measurement	2.3‡	3.3
Aspirin	0.6	0.5
Of visits by patients with hypertension, percentage difference		
Blood pressure measurement	1.0	3.5
Blood pressure medications	−6.7*	−19.0*
Angiotensin-converting enzyme inhibitors	−4.1†	−4.2
β-Blockers	0.2	1.5
Thiazide diuretics	−1.1	−12.9*
Of visits by patients with hyperlipidemia, percentage difference		
Cholesterol advice	−13.0†	−2.7
Lipid-lowering medications	−10.1‡	0.1
Of visits by patients who are smokers, percentage difference		
Smoking counseling	−1.9	1.6
Of visits by patients with obesity, percentage difference		
Weight reduction counseling	8.3†	2.0
Exercise counseling	9.4*	7.2
Obesity medications	4.7*	0.4

**P < .001, testing the hypothesis that there is no difference between 1995–1996 and 1992 rates.*
†.001 < P < .01.
‡.01 < P < .05.

specialty did not have significant impact on provision of prevention services. We found no consistent statistical interaction between diabetes and patient characteristics on provision of most prevention services.

Cardiovascular disease prevention practices in 1995 and 1996 were similar to those in 1992 (Table 4). Both for patients with and for patients without diabetes, changes over time were small in magnitude and did not necessarily suggest improvements. For diabetic patients provision of cholesterol advice, weight reduction advice, and antihypertensive medication prescription (among those with hypertension) actually became less common. For patients without diabetes, there were some improvements (exercise counseling and blood pressure measurement in all patients, and exercise counseling and weight reduction advice in obese patients), but also simultaneous declines in several other services including provision of cholesterol advice or antihypertensive medication prescription.

DISCUSSION

Despite their substantial risk of developing and dying from coronary heart disease or stroke, we have demonstrated that patients with diabetes mellitus visiting U.S. physicians inconsistently and only modestly received more outpatient CVD prevention services than patients without diabetes. We have specifically focused on primary prevention, or services provided to patients without diagnosed CVD. Although patients with diabetes were more likely to receive services related to hypertension, hyperlipidemia, physical activity, and obesity, this was not consistent across different diabetes treatment groups. Smokers with diabetes were no more likely to receive counseling for smoking cessation than smokers without diabetes.

We defined diabetes using several coding options available on the NAMCS data record and excluded younger patients to minimize inclusion of those with type 1 diabetes of shorter duration, in whom metabolic or microvascular complications are the principal causes of morbidity and mortality.[45] We included patients likely to have type 2 diabetes, treated in a variety of ways, including insulin, oral hypoglycemic medication, and those not receiving di-

abetes-specific medications. We stratified our analyses by treatment group as a proxy for severity, hypothesizing that greater severity of diabetes would lead to more aggressive CVD prevention activities. Contrary to our expectations, CVD risk factor interventions did not necessarily increase in intensity for patients whose diabetes was treated more intensively. In general, diabetic patients treated with oral hypoglycemic medications tended to receive more services than patients receiving diet therapy only or insulin therapy. It may be that among patients on insulin therapy the focus on glycemic control superceded attention to reducing other risk factors.[11] As patients with diabetes not receiving diabetes-specific therapy are also at substantially elevated risk of CVD,[46] rates of CVD prevention practices equivalent to those provided to patients treated with diabetes medication were probably appropriate.

Although CVD prevention activities occurred more often among patients with diabetes, absolute rates of provision of many prevention services were still lower than expected based on national treatment recommendations. The American Diabetes Association, the Joint Committee on Detection, Evaluation, and Treatment of High Blood Pressure, and the National Cholesterol Education Program specifically identify diabetes as a high CVD-risk state; consensus statements or clinical practice recommendations encouraging aggressive treatment of hypertension, hyperlipidemia, and cigarette smoking were all published and available to clinicians during or before our sampling dates 1992–1996.[30,34,47–49] Clinical trials results strongly supporting these recommendations were published subsequently.[16–20,22–26] While diabetic patients with hypertension had blood pressure measurements at the majority of office visits, at only half of these visits did patients receive an antihypertensive prescription, and, remarkably, rates of antihypertensive prescription fell by nearly 20% between 1992 and 1995. Rates of treatment for hyperlipidemia among diabetic patients were relatively high, with patients receiving lipid-lowering prescriptions at two thirds of visits. Cigarette smoking has especially adverse effects among patients with diabetes, yet cigarette smokers with diabetes received smoking cessation counseling at only a quarter of visits. Rates of prophylactic aspirin prescription were very low. While aspirin therapy guidelines for patients with diabetes were published only recently,[33] clinical trials results demonstrating efficacy of prophylactic aspirin therapy in diabetes subgroups were available before or during our sampling period.[27,28] We found no significant increases, and in many cases significant decreases, in most CVD prevention practices between 1992 and 1995–1996.

The "right" rate for provision of CVD prevention services is not known. The unit of analysis in the NAMCS data is an individual patient visit; patients with more visits (e.g., diabetic patients) might be expected not to have all services provided at every visit, and therefore appear to have lower rates of some services provided. New and ongoing medication prescriptions are recorded at every NAMCS visit; thus, rates of medication prescription in the NAMCS data are likely to reflect physician prescription practices for individual patients over time. The low rate of aspirin prescription, for example, is probably close to an accurate measure of limited use of this important prevention intervention. Low rates of patient screening and counseling services do probably reflect that these services were not provided at all of the relatively frequent visits by diabetic patients (estimated at about 5 ambulatory visits per year[45]). Also, some counseling and screening interventions may have been provided by nonphysicians (e.g., nurses or diabetes educators); provision of these services was not captured in the NAMCS data, and their rates of provision may be underestimated. Conversely, counseling and screening services may be overreported by physicians in the setting of the NAMCS study, where the Hawthorne effect causes physicians to improve practice behaviors while under observation. Nonetheless, it can be argued that certain counseling or screening services should be provided at most visits. For smoking cessation counseling, in particular, we think that every visit should provide the opportunity to encourage patients to overcome this deadly adverse health behavior. Another limitation of our NAMCS sample is our focus on visits to primary care physicians, endocrinologists, and cardiologists. Patterns of care provided to patients of these physicians may differ from patterns in the general population of patients with and patients without diabetes.

These NAMCS data add to accumulating evidence from local community surveys or from chart review studies that evidence-based guidelines are inconsistently applied to the care of patients with diabetes. It is notable that no published studies of diabetes care prior to this report have included any comprehensive, detailed information on CVD prevention practices; prior research in this area has focused almost exclusively on care related to glycemic control and screening for microvascular complications. The following few studies provided the only data we could find directly related to CVD prevention in diabetes. In the San Antonio Heart Study, fewer than 10% of participants with diabetes and hyperlipidemia surveyed in 1979 to 1988 reported hyperlipidemia treatment.[50] In a 1991 community survey in Michigan, over 60% of diabetes patients reported having hypertension, and of these, about 80% reported receiving antihypertensive therapy.[51] Among nearly 400 diabetes patients cared for in two different large HMOs, chart review revealed that 86% to 90% of patients had at least 1 or 2 blood pressure checks during a 1- or 2-year sampling window during 1990 to 1994, but only 32% to 60% had at least 1 cholesterol determination.[52,53] Chart review data from 790 diabetes patients cared for at 42 different institutions between 1989 and 1993 revealed that 62% to 90% had a cardiovascular examination (presumably including blood pressure assessment) and 36% to 64% had an annual lipid profile. Among a national cohort of patients surviving acute myocardial infarction in 1994 or 1995, only 47% of 11,716 patients

with diabetes were discharged on β-blocker therapy; these patients were less likely (relative risk, 0.93; 95% CI, 0.91 to 0.95) than patients without diabetes to have received β-blockers.[54] All these investigators concluded that there is ample room for improvement in diabetes care overall. Our study provides specific data highlighting the need for improved provision of potentially life-saving CVD-specific prevention practices.

All major clinical guidelines focused on CVD prevention were available before or during our study period, and since 1995 a large number of clinical trials have solidified the evidence base for CVD risk factor management in diabetes. It is quite clear that aggressive management of hyperlipidemia almost certainly prolongs the lives of patients with diabetes and clinically evident coronary heart disease.[16,18–20] Patients with diabetes but without evidence of coronary heart disease may also benefit from cholesterol lowering.[17] Because these patients are also at very high risk of CVD events,[55–57] the American Diabetes Association recently recommended a low-density lipoprotein cholesterol goal of <100 mg/dL for all diabetic patients.[32]

Recent data from the U.K. Prospective Diabetes Study clearly demonstrate that aggressive blood pressure control lowers mortality rates in diabetic patients with hypertension.[23] However, the best specific drug therapy for treatment of hypertension in diabetes remains a particularly confusing issue. Of the three classes of antihypertensive therapy we considered, ACE inhibitors were prescribed more commonly than thiazide diuretics or β-blockers, despite scant experimental evidence prior to 1998 that hypertension therapy with ACE inhibitors reduces cardiovascular or all-cause morbidity or mortality in either diabetic or nondiabetic patients. Such evidence did exist during our study period for low-dose thiazide diuretic and cardioselective β-blocker-based treatment regimens used as a primary prevention strategy in diabetes,[21,22] and for β-blocker therapy among diabetic patients with diagnosed CVD.[58–62] Both the U.K. Prospective Diabetes Study and the Captopril Prevention Project trial have now demonstrated that captopril and β-blocker-based treatment programs are equally effective for reducing complications and death related to diabetes.[23,25] The ACE inhibitors may have a special role in treatment for type 2 diabetes patients with microalbuminuria and either hypertension or normal blood pressure,[63,64] but β-blocker therapy may have a similar beneficial effect.[65] We did not have information on microalbuminuria or diabetic nephropathy and could not stratify the analysis by this important complication. However, about one quarter of people with older-onset diabetes have microalbuminuria, with higher rates observed among insulin-treated compared with non-insulin-treated subjects.[66] Paradoxically, we observed lower rates of ACE inhibitor use among hypertensive diabetic patients treated with insulin. However, ACE inhibitor therapy is not without risk,[67] and while there has been concern about adverse metabolic or mortality effects of thiazide diuretic or β-blocker use in diabetes,[68–70] subsequent work suggests that these concerns are probably overstated.[22,71,72] The role of calcium channel blockers for treatment of hypertension in diabetes remains uncertain. Some studies suggest benefit with their use,[24,26] but others found worrisome adverse outcomes.[73,74] Current recommendations and expert opinion continue to recommend β-blocker or thiazide-based programs for treatment of hypertension in diabetes.[35,75] Our analysis demonstrates low overall rates of antihypertensive therapy among hypertensive diabetic patients, and further raises concern about especially low rates of use of β-blockers and thiazide diuretics.

Despite some limitations imposed by the NAMCS design, we have documented that patients with diabetes cared for by U.S. office-based physicians do not appear to have received appropriately aggressive management of CVD risk factors. The burden of morbidity, mortality, and resource use associated with the CVD complications of diabetes make better management of CVD risk factors a critical issue for quality improvement efforts in diabetes care. Among potential strategies, the traditional emphasis on glycemic control must be broadened to include a stronger evidence-based emphasis on CVD prevention. Wider physician education and enhanced information management tools also may help to expand use of interventions to lower blood pressure and lipoprotein cholesterol levels and increase smoking cessation counseling and prophylactic aspirin use—all areas where strong clinical trials results and observational evidence suggest significant reduction in morbidity and mortality for patients with diabetes.

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