Health Care and Health Status and Outcomes for Patients With Type 2 Diabetes

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OBJECTIVE — To evaluate access and utilization of medical care, and health status and outcomes that would be influenced by recent medical care, in a representative sample of patients with type 2 diabetes.

RESEARCH DESIGN AND METHODS — A national sample of 733 adults with type 2 diabetes was studied from 1991 to 1994 in the Third National Health and Nutrition Examination Survey. Structured questionnaires and clinical and laboratory assessments were used to determine the frequencies of physician visits, health insurance coverage, screening for diabetes complications, treatment for hyperglycemia, hypertension, and dyslipidemia; and the proportion of patients who met treatment goals and established criteria for health outcome measures including hyperglycemia, albuminuria, obesity, hypertension, and dyslipidemia.

RESULTS — Almost all patients had 1 source of primary care (95%), 2 or more physician visits during the past year (88%), and health insurance coverage (91%). Most (76%) were treated with insulin or oral agents for their diabetes, and 45% of those patients taking insulin monitored their blood glucose at least once per day. The patients were frequently screened for retinopathy (52%), hypertension (88%), and dyslipidemia (84%). Of those patients with hypertension, 83% were diagnosed and treated with antihypertensive agents and only 17% were undiagnosed or untreated; most of the patients known to have dyslipidemia were treated with medication or diet (89%). Health status and outcomes were less than optimal: 58% had HbA_{1c} >7.0, 45% had BMI >30, 28% had microalbuminuria, and 8% had clinical proteinuria. Of those patients known to have hypertension and dyslipidemia, 60% were not controlled to accepted levels. In addition, 22% of patients smoked cigarettes, 26% had to be hospitalized during the previous year, and 42% assessed their health status as fair or poor.

CONCLUSIONS — Rates of health care access and utilization, screening for diabetes complications, and treatment of hyperglycemia, hypertension, and dyslipidemia in type 2 diabetes are high; however, health status and outcomes are unsatisfactory. There are likely to be multiple reasons for this discordance, including intractability of diabetes to current therapies, patient self-care practices, physician medical care practices, and characteristics of U.S. health care systems.

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Considerable attention has been garnered by the concept that health care access and utilization are major determinants of health outcomes for patients with diabetes. For example, the Diabetes Quality Improvement Project was created in 1998 because of the perception that diabetes care in America is suboptimal and that patients with diabetes are not receiving care thought to be beneficial (1). This major project, sponsored by many organizations involved with diabetes, is designed to increase the level of care provided to patients with diabetes and to improve the accountability of health care systems.

Health outcomes for patients with diabetes do appear to be suboptimal, in that blindness, renal failure, lower-extremity amputations, ischemic heart disease, and stroke are common in these patients (2). However, these end-stage complications result only after a long duration of diabetes and thus, are occurring in patients who were diagnosed and received much of their medical care many years ago. The current contribution of health care access and medical care to the development of adverse health outcomes in diabetes versus the contributions of patient self-care practices, provider care practices, and inherent biological factors remains to be determined.

Certain data indicate that health care access may not be a major determinant of the health status of patients with type 2 diabetes. In a representative group of U.S. patients, there was no relationship of glycemic control to having health insurance or number of physician visits per year (3). In the U.K. Prospective Diabetes Study (UKPDS), only a small difference in mean HbA_{1c} was achieved between the group of patients who were intensively treated compared with the group less intensively treated (4). Physician specialty, particularly whether the physician is an endocrinologist, was reported to have little impact on quality of care, as measured by glycemic control, blood pressure control, or microalbuminuria (5).

To investigate the current relationship between medical care and health status and outcomes, we analyzed questionnaire, clinical, and laboratory data for a representative sample of patients with type 2 diabetes in phase 2 of the Third National Health and Nutrition Examination Survey (NHANES III). The health outcomes studied were those that would be expected to be influenced by recent medical care, such as hyperglycemia, albuminuria, hypertension, and dyslipidemia.

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Abbreviations: NHANES III, Third National Health and Nutrition Examination Survey; UKPDS, U.K. Prospective Diabetes Study; VA, Veterans Administration.

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

Table 1—*Health care access and medical care practices for adults with type 2 diabetes*

Health care access and medical care category	% of patients
Has 1 usual source of ambulatory medical care	94.8 (1.5)
Sees 1 primary physician at this source	92.4 (2.2)
Had 2 or more physician visits in past 12 months	88.0 (2.0)
Has health insurance	90.7 (2.1)
Has private health insurance	65.8 (3.2)
Diabetes therapy	
Treated with insulin, at least 2 injections per day	17.0 (1.3)
Treated with insulin, 1 injection per day	11.3 (1.0)
Treated with oral agents	47.5 (3.4)
Not treated with insulin or oral agents	24.2 (2.2)
Takes 3 or more prescription medicines	52.9 (2.9)
Self-monitors blood glucose at least once per day	
Insulin treated	44.7 (6.1)
Not insulin treated	6.6 (2.5)
Had dilated eye examination in the past year	52.1 (2.8)
Had blood pressure checked in the past 6 months	87.7 (1.9)
Has had cholesterol checked	83.7 (2.1)
Has hypertension	
Previously diagnosed, taking antihypertensive medication	81.6 (2.0)
Previously diagnosed, not taking antihypertensive medication	7.1 (1.1)
Undiagnosed	11.3 (1.5)
Has dyslipidemia	
Previously diagnosed, treated with diet or medication	53.1 (3.1)
Previously diagnosed, not treated with diet or medication	6.4 (1.0)
Undiagnosed	40.4 (2.5)

Data are % (SEM). Data on dyslipidemia exclude 13% of subjects with triglyceride levels ≥400 mg/dl, for whom the Friedewald equation is not valid.

RESEARCH DESIGN AND METHODS

Phase 2 of NHANES III was conducted from September 1991 to October 1994 and included a stratified probability sample of the U.S. population. Participants were interviewed in their homes and were given a standardized set of examinations and laboratory measurements in an examination center. There were 8,420 participants 25 years of age or older, of whom 804 had been diagnosed with diabetes before the survey. Women with diabetes diagnosed only during pregnancy (n = 55) and subjects with type 1 diabetes, defined as those with age at diagnosis <30 years who had continuous insulin use since diagnosis (n = 13), were deleted from the analysis. The remaining 733 subjects were considered to have type 2 diabetes.

Information was obtained by structured questionnaires on health insurance, use of physician services, diabetes therapy, self-monitoring of blood glucose levels, frequency of dilated eye examinations, frequency of blood pressure and blood cholesterol screening, self-assessed health status, hospitalizations, and cigarette smoking. Use of medications for treatment of hypertension and dyslipidemia was ascertained by self-report and by examination of prescription medicine containers and recording of the name of the medicine by the interviewer. Measurements of height, weight, HbA_{1c}, urine albumin and creatinine, blood pressure, lipids, and homocysteine were made during a separate clinical examination in which 90.5% of the interviewed subjects participated. HbA_{1c} was measured by a high-performance liquid chromatographic assay as used in the Diabetes Control and Complications Trial. Urine albumin was measured by a solid-phase fluorescent immunoassay (6). Urine creatinine was measured by a Jaffe rate reaction in which creatinine reacts with picrate in an alkaline solution to form a creatinine-picrate complex, which was read with an ASTRA clinical analyzer (Beckman Instruments, Fullerton, CA). Microalbuminuria was defined as a urinary albumin-to-creatinine ratio of 30–300 μg/mg; clinical proteinuria was defined as a urinary albumin-to-creatinine ratio of >300 μg/mg. Blood pressure was measured with a standard mercury sphygmomanometer. Up to 3 measurements during the household interview and up to 3 measurements during the physical examination were made, with the participant in the sitting position after 5 min of rest. The means of all systolic and diastolic blood pressures were used to evaluate hypertension. Hypertension was defined as systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg or treatment with antihypertensive medication. Serum total cholesterol was measured enzymatically (7) using a commercially available reagent mixture (Cholesterol/HP; Boehringer Mannheim Diagnostics, Indianapolis, IN). HDL cholesterol was measured in supernatants after the precipitation of apolipoprotein B–containing lipoproteins with heparin-manganese chloride and the removal of excess manganese by precipitation with sodium bicarbonate (8). Triglycerides were analyzed enzymatically using commercially available reagents (Agent Triglycerides Reagent Set; Abbott Laboratories, Chicago). LDL cholesterol was calculated using the Friedewald equation for those subjects with triglyceride <400 mg/dl (9); dyslipidemia was defined as LDL cholesterol ≥130 mg/dl or treatment with prescribed diet or medication.

Definitions of treatment goals and abnormal values for HbA_{1c}, proteinuria, obesity, blood pressure, blood lipids, and homocysteine are those recommended by the American Diabetes Association; the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure; the National Cholesterol Education Program; the National Kidney Foundation; and the American Heart Association (10–14).

Statistical analyses were carried out using SAS (Cary, NC) with appropriate sampling weights to adjust for the stratified sample design. Standard errors were calculated and logistic regression was performed using SUDAAN (Research Triangle Institute, Research Triangle Park, NC), a computer program that adjusts for the cluster sample design in computing variance.

RESULTS

Health care access and medical care practices

Measures of health care for patients with diabetes are shown in Table 1. Almost all of the patients had 1 primary source of ambulatory medical care, described as a physician's office, clinic, or health center. Most of these patients consistently saw 1 specific

physician at this source; 88% had at least semiannual visits and 65% had at least quarterly visits. Patients taking insulin had a higher visit rate (median 5.2 per year) than patients treated with oral agents or diet alone (median 3.8 per year).

Almost all of the patients (91%) had health insurance of some type with 66% covered through private insurance, 46% by Medicare, 15% by Medicaid, and 7% by Champus or the Veterans Administration (VA). Approximately 40% had multiple types of health insurance coverage. Of those patients covered by private insurance, 44% had Medicare coverage and 9% had Medicaid or Champus/VA. Among the patients with Medicare, 63% had private insurance and 24% had Medicare and/or Champus/VA; and among those with Medicaid, 13% had private insurance and 63% had Medicare.

The majority of patients were treated with insulin or oral agents for their diabetes (Table 1); only 4% were treated with both insulin and oral agents. Insulin use increased from 18% among the patients with <5 years since diagnosis of diabetes to 56% among those with ≥15 years' duration. Concomitantly, use of oral agents declined from 60 to 25%. Of insulin-treated patients, ~60% took at least 2 injections per day. Use of prescription medicines was common; more than half of the patients took 3 or more prescribed medications, and 20% took 6 or more.

Self-monitoring of blood glucose was more common among insulin-treated patients, of whom 68% monitored at least once per week and 45% monitored at least once per day, than among those who were not treated with insulin (26 and 7%, respectively). Self-monitoring at least once per week was also more common among those with HbA_{1c} ≥8% (47%) than among those with HbA_{1c} <8% (32%). Urine glucose testing, at least once per week, was performed by 14% of the patients taking insulin and 8% of those not taking insulin.

Two-thirds of the patients had a dilated eye examination during the previous 2 years and one-half had an examination during the past year. Almost all of the patients had their blood pressure checked within the past 6 months, and most had their cholesterol measured (Table 1).

Clinical hypertension was present in 63% of patients. Of those patients with hypertension, 82% were being treated with antihypertensive medication, and hypertension was undiagnosed or untreated in only 18% (Table 1). Dyslipidemia was present in 67% of patients; of those with dyslipidemia, 60% were diagnosed, almost all of whom were being treated with medication or a prescribed diet, but 40% of those with dyslipidemia were undiagnosed.

Health status and outcomes

Health status and outcome measures for patients with diabetes are shown in Table 2. At least 58% had an HbA_{1c} value >7.0%, which is the recommended treatment goal for blood glucose control, including 73% of the insulin-treated patients, 61% of the patients taking oral agents, and 35% of those treated with diet alone. Mean HbA_{1c} was 7.8%; this was >5 SD above the mean value of 5.2% for nondiabetic adults with normal fasting glucose (<110 mg/dl). Mean HbA_{1c} was similar for those treated with insulin (8.3%) or oral agents (8.0%) and was lower for those who were treated with diet alone (6.7%).

The majority of patients were overweight: 44% of men and 47% of women had BMI >30, and only 18% had BMI <25. More than one-third of the patients had microalbuminuria or clinical proteinuria (Table 2).

Of those whose hypertension had been diagnosed before the survey, 59% were not controlled to the level of <140/90 mmHg. Together with those who were newly found to have hypertension at the time of the survey, 40% of all patients had uncontrolled hypertension (Table 2). Most of the uncontrolled blood pressure was due to isolated systolic hypertension (81%), with elevated systolic and diastolic pressures occurring together (10%) or elevated diastolic pressure occurring alone (9%) being substantially less common.

An aggressive approach, including dietary changes and drug therapy, is recommended for diabetic patients who have LDL cholesterol values ≥130 mg/dl. In NHANES III, among those who had previously been diagnosed with dyslipidemia, only 41% had LDL cholesterol <130 mg/dl. In addition, about one-fourth of all of the patients had undiagnosed dyslipidemia. In sum, 51% of the patients had LDL cholesterol ≥130 mg/dl. The percentage distributions for total cholesterol, HDL cholesterol, triglycerides, and LDL cholesterol are shown in Table 2. Large proportions of diabetic patients had levels that were above normal for each lipid variable. Elevated levels of lipoprotein(a) and homocysteine were found in 27 and 13%, respectively.

Table 2—*Health status and outcomes for adults with type 2 diabetes*

Health status and outcome category	% of patients
HbA_{1c} (%)	
<6.0	22.2 (3.5)
6.0–7.0	20.1 (3.4)
7.0–8.0	17.0 (2.7)
8.0–9.0	15.7 (2.4)
9.0–10.0	9.8 (1.8)
≥10.0	15.2 (2.5)
BMI ≥30 kg/m^2	45.3 (3.7)
Microalbuminuria	28.2 (3.2)
Clinical proteinuria	7.6 (1.7)
Hypertension (mmHg)	
Previously undiagnosed, ≥140/90	7.1 (1.6)
Previously diagnosed, ≥140/90	32.8 (2.5)
Previously diagnosed, <140/90	23.1 (3.1)
Not hypertensive	37.0 (2.2)
Dyslipidemia (mg/dl)	
Previously undiagnosed, ≥130	27.1 (3.5)
Previously diagnosed, ≥130	23.6 (3.7)
Previously diagnosed, <130	16.3 (1.9)
Not hyperlipidemic	33.0 (4.2)
Serum total cholesterol (mg/dl)	
<200	32.1 (2.1)
200–239	34.3 (4.0)
≥240	33.6 (4.3)
HDL cholesterol (mg/dl)	
<35	27.6 (3.3)
35–45	34.5 (3.5)
>45	37.9 (2.9)
Triglyceride (mg/dl)	
<200	58.4 (3.3)
200–399	29.0 (2.6)
≥400	12.6 (1.6)
LDL cholesterol (mg/dl)	
<100	15.4 (1.8)
100–129	33.9 (4.4)
130–159	30.2 (3.3)
≥160 mg/dl	20.5 (3.8)
Lipoprotein(a) >30 mg/dl	26.5 (2.4)
Homocysteine >15 μmol/l	13.4 (2.5)
Cigarette smoker	22.2 (2.8)
Self-assessed health status fair or poor	42.4 (1.5)
Hospitalized in past 12 months	26.2 (2.2)

Data are % (SEM). Data on dyslipidemia exclude 12.6% of subjects with triglyceride levels ≥400 mg/dl, for whom the Friedewald equation is not valid.

Of the patients, ~22% were current cigarette smokers and 42% assessed their health status as fair or poor, with only 20% having excellent or good health. One-fourth had conditions that required hospitalization during the prior year.

The frequency of adverse outcomes was distributed across the group of patients and was not clustered in any of the subsets of patients. For the clinical outcomes of hyperglycemia (HbA_{1c} >7.0), obesity (BMI >30), albuminuria, uncontrolled hypertension (≥140/90 mmHg), and uncontrolled hyperlipidemia (LDL cholesterol ≥130 mg/dl), most patients had either 1 (27%), 2 (29%), or 3 (26%) occurrences. In logistic regression analysis adjusted for age, sex, race, and duration of diabetes, these outcomes were not significantly associated with having a primary source of ambulatory medical care, number of physician visits per year, having any type of health insurance, or having private insurance ($P > 0.2$).

CONCLUSIONS — These data, from a representative national survey, indicate that the frequencies of health care access and utilization, screening for diabetes complications, and treatment of hyperglycemia, hypertension, and dyslipidemia in patients with type 2 diabetes are high. The patients had extensive and frequent contact with the health care system and had health insurance. Most of the patients were treated with insulin or oral agents for their diabetes, and many monitored their own blood glucose levels. The patients were frequently screened for retinopathy, hypertension, and dyslipidemia. Only a small proportion of those with hypertension were undiagnosed or untreated. Most of the patients known to have dyslipidemia were being treated with medication or diet.

The NHANES III data also indicate, however, that health status and outcomes are far from optimal. Glycemic control was poor, many patients were obese and had albuminuria, much of the hypertension and dyslipidemia was not controlled, one-fourth of patients had to be hospitalized during the previous year, and one-fifth of patients smoked cigarettes. In sum, there appears to be discordance between health care access and health outcomes in type 2 diabetes.

If access and utilization of medical care is not an issue in the health status of patients with diabetes, what factors might be determining the poor outcomes in diabetic patients? The disease may simply be inherently resistant to current treatment methods. Diabetes is perceived to be significantly more difficult to manage than other common chronic conditions (15). The NHANES III data indicate that control of hyperglycemia, hypertension, dyslipidemia, and other risk factors for diabetes complications is complex. Even in the setting of the UKPDS clinical trial of glycemic control of patients with type 2 diabetes, fasting glucose increased markedly over 9 years of follow-up, reflecting progressive failure of islet function (16). The intractability of obesity in diabetic patients to treatment is well recognized.

There may be inadequate use or underutilization of medications to treat hyperglycemia, hypertension, and dyslipidemia. Monotherapy with diet, sulfonylurea, or insulin becomes increasingly less effective with time, and the majority of patients require multiple therapies to achieve glycemic control over the long term (16). In NHANES III, the proportion of patients taking oral agents decreased with longer duration of diabetes and the proportion taking insulin increased, implying that patients were being transferred from oral agents to insulin rather than adding a second therapy. Only 4% used both insulin and oral agents.

Some under-utilization of medication may be due to failure by patients to take the medications they have been prescribed. For example, among patients who were prescribed oral agents to take twice per day, on only 66% of days was this regimen followed (17). Difficulties with medication occur more often among older patients and those taking multiple medications, which were characteristics of the NHANES III patients.

Inadequate patient skills, knowledge, and motivation about self-care are important determinants of adverse health outcomes. Daily self-care is a central element in the management of diabetes, and semiannual or quarterly visits to physicians, such as those of the NHANES III patients, are insufficient for this daily care. Although many NHANES III patients did not monitor their blood glucose levels as frequently as might be deemed optimal, the efficacy of self-monitoring in type 2 diabetes is questionable (18). Physicians routinely indicate that noncompliance by patients with diabetes is the most common barrier to care (19), but there can be a marked gap between patients' receipt of information about self-care from their physicians and the patients' absorbing or retaining this information (20).

Physician practice behaviors and settings are influential in determining health outcomes in diabetes. Most primary care for diabetes is delivered by internists and general and family practitioners. Physicians who see more than the average number of patients per unit of time tend to have lower rates of testing for HDL cholesterol and proteinuria and of referrals for ophthalmic examination (21). Even though diabetes is a common condition, physicians may not see many patients with diabetes; in 1 large staff-model health maintenance organization, >90% of the primary care physicians had <60 patients with diabetes (22). Many primary care physicians do not have organized systems for care of chronic illness (23).

Adequate co-involvement of the medical care team, the patient, and the family appears to be sentinel in effective management of diabetes. Clinical trials have demonstrated that health care systems that use nurses and other nonphysician personnel as case managers and those with telephone-based contact are efficacious in improving glycemic control, blood pressure, and lipid levels (24–27). A key element in the success of the Diabetes Control and Complications Trial was the frequent clinic visits involving nurses and dietitians, and the extensive telephone access to these health care practitioners afforded to patients in the intensive intervention group in which HbA_{1c} remained low throughout the study (28). Availability of social support, such as that provided by nurse case managers, appears to be a major factor that contributes to adherence by diabetic patients to such behaviors as following a diabetic diet, weight loss, taking prescribed medications, checking blood glucose, and checking feet (29).

In summary, although rates of health care access, screening for diabetes complications, and treatment of hyperglycemia, hypertension, and dyslipidemia in type 2 diabetes are high, health status and outcomes are unsatisfactory. There are likely to be multiple reasons for this discordance, including intractability of diabetes to current therapies, patient self-care practices, physician medical care practices, and characteristics of U.S. health care systems.

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