Diabetes Care by Primary Care Physicians in Minnesota and Wisconsin

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Background. The purpose of this study was to identify the characteristics of diabetes care delivered by primary care physicians.

Methods. Twenty-seven primary care physicians recruited through the Minnesota Academy of Family Physicians Research Network and the Wisconsin Research Network recorded a sample of 240 visits for care of patients with diabetes mellitus. Information was collected concerning physician and patient demographics, practice characteristics, and patterns of delivery of diabetes care including referral and clinical outcomes.

Results. Seventeen percent of the patients in this study had type I diabetes mellitus; 81% had type II. Fourteen percent of the patients with type I diabetes and 20% of patients with type II were within their target glucose range. Average hemoglobin-A_{1c} was 10.0% ± 3.4% and 8.9% ± 2.3% for patients with type I and type II diabetes, respectively (normal, 4.0% to 6.1%). Two distinct patterns of referral existed for patients with newly diagnosed type I diabetes: 44% of physicians rarely referred these patients, whereas 20% almost always referred. Although distance to specialists increased as community size decreased, frequency of referral was not related to practice location. Ninety-five percent of physicians in this study were directly involved in the diabetes education of their patients, and 56% had no certified diabetes educator available.

Conclusions. Over the course of this study, patients frequently persisted with treatment regimens that failed to stabilize blood glucose values. With recent evidence that improved glucose control may delay or prevent diabetes complications, it is increasingly important for the primary care physician to optimize available resources to improve glucose control in patients with diabetes in an effort to improve long-term clinical outcomes.

Key words. Diabetes mellitus; delivery of health care; primary health care; practice-based research network.
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Diabetes mellitus is one of the most common and costly chronic diseases, afflicting approximately 14 million Americans and having an estimated cost to this country of $20 billion per year.[1] Although treated by many different medical specialists, the vast majority of diabetes care is delivered by primary care physicians. In 1985, primary care physicians in family medicine, internal medicine, general practice, and pediatrics provided 76% of all outpatient care and 97.5% of the primary care for patients with diabetes in the United States.[2]

The delivery of medical care by primary care physicians is characterized by continuity, comprehensiveness, and first contact with the patient.[3] Found in the National Ambulatory Medical Survey (1985) to be the seventh most common diagnosis for an office visit to primary care physicians, diabetes mellitus accounts for between 1.9% and 3.3% of total office visits to primary care physicians in the United States.[2,4] Because of the often complicated nature of diabetes care, however, the number of office visits underrepresents the time and effort these physicians actually expend in providing care. A better estimate is found in a Michigan study of eight communities,

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wherein 48 family physicians estimated that an average of 8% of their time was spent with patients with diabetes.[5]

The Diabetes Control and Complications Trial (DCCT), a 10-year multicenter clinical trial sponsored by the National Institutes of Health (NIH), confirmed that the onset and progression of the complications of diabetes mellitus were directly associated with the level of glucose control in patients with type I diabetes mellitus.[6] Intensive therapy for hyperglycemia resulted in a delay in the onset and a major slowing of the progression of microvascular complications associated with diabetes. Although patients with type II diabetes did not participate in the DCCT, the American Diabetes Association (ADA) subsequently suggested that since the underlying mechanism of the disease is probably similar in both type I and type II diabetes mellitus, patients with type II diabetes should consider striving to achieve the normal or near-normal blood glucose levels achieved in the DCCT. Of course, many other factors must be considered to determine how appropriate strict glucose control is for any individual patient, including age, weight, compliance, likelihood of complications resulting from therapy, presence of significant comorbidities, and other risk factors. Nevertheless, such recommendations have major therapeutic implications for primary health care providers. Despite diabetes being a relatively common problem seen by primary care physicians, resources available for the delivery of diabetes care in any given office are limited. Although some authorities use this argument to justify the referral of all patients with diabetes to specialized centers, this presumes an unrealistic assessment of the access and care capabilities of the medical delivery system within the foreseeable future.

In view of these developments, further evaluation of primary care of patients with diabetes mellitus is necessary. The purpose of this study was to determine baseline characteristics of diabetes care delivery in primary care offices in the upper Midwest region. Understanding these characteristics will facilitate better diabetes care delivery by identifying the needs of both the patient with diabetes and the primary care physician.

Methods

Physicians were recruited for participation through the Minnesota Academy of Family Physicians Research Network (MAFPRN) and the Wisconsin Research Network (WReN) beginning in April 1992. Each network sent to members a letter of introduction and an accompanying short description of the proposed study. All MAFPRN members (n = 54) and a random selection of WReN members (n = 100) were contacted, and physicians volunteered to take part in the study. Only the first physician responding from any given practice was accepted, and physicians without practices were excluded. Following consent, physicians completed a survey, which included questions regarding practice patterns, diabetes care delivery, and physician birth date, sex, year of completion of medical degree, graduate medical education, board certification, and the year the physician entered practice. Information about practice characteristics, such as location, size of the community served, services offered, distance from metropolitan areas, and distance from consultants, was obtained. Delivery of diabetes care was assessed through questions regarding the use of diet, oral hypoglycemic agents, and insulin therapy, and complications surveillance. Physicians were also asked to estimate how often the services of dietitians or certified diabetes educators were used and to characterize referrals to specialist physicians.

Participating physicians were asked to identify 10 consecutive patients presenting for diabetes-related care. Patients with gestational diabetes mellitus were excluded. A three-part data sheet was used to collect clinical information. Part 1, which was completed by the physician at the time of the initial patient visit, addressed type of diabetes, diagnostic criteria, family history, and information concerning complications. Information concerning diabetes treatment, frequency and method of glucose testing, blood glucose ranges, frequency of hypoglycemia, exercise, and current glycosylated hemoglobin-A_{1c} (HbA_{1c}) results were recorded. Physicians also were asked to record each patient's individual target blood glucose and target HbA_{1c} if determined. A copy of the data sheet was kept in each patient's medical record, and parts 2 and 3 were completed at the next two diabetes-related clinic visits. At each subsequent visit, information concerning diabetes treatment, frequency and method of glucose testing, blood glucose ranges, frequency of hypoglycemia, exercise, and current glucose and HbA_{1c} results were recorded. At the completion of the study, records were collected. Data were analyzed with the aid of bubble processing software and entered into a computer database.[7] Patients not returning to the clinic within 12 months had no second or third visit recorded. Physicians were not given guidelines for care delivery or frequency of follow-up and were asked not to vary their usual practice for the study.

Following the return of the data sheets, clinical management was evaluated. A stage of care was identified for each patient that reflected the therapeutic intervention.[8] Stages identified for type I diabetes therapy were: stage 1, one injection of single or mixed insulin; stage 2, two injections of single or mixed insulin, one each in the morning and evening; stage 3, three injections, one of

single or mixed insulin in the morning, one of regular insulin in the evening, and one of intermediate-acting insulin in the late evening; or one injection of single or mixed insulin in the morning, one of regular in the afternoon, and one of single or mixed insulin in the evening.

Stages identified for type II diabetes therapy were: stage N (nutrition), diet therapy only; stage O, oral agent and meal plan; stage 1, one injection of single or mixed insulin; stage 2, two injections of single or mixed insulin, one each in the morning and evening; and stage CT, combination therapy utilizing oral hypoglycemic agents and insulin.

Two types of patient outcomes were calculated. The percentage of patients achieving their individual glucose target level was calculated for patients with type I and patients with type II diabetes for each visit. A patient was considered within target if more than 66% of home glucose values were within the patient's target range or, when not on home monitoring, if current office glucose testing was within the patient's target levels. Patients without current home or office glucose testing were categorized according to the last glucose test known to the physician. In addition, the average HbA_{1c} was calculated for patients with type I and patients with type II diabetes for each of the three physician visits.

Results

Physician Demographics

Responses were received from 27 eligible primary care physicians throughout Minnesota (MAFPRN, n = 18) and Wisconsin (WReN, n = 9) agreeing to participate in the study. Twenty-two physicians (81%) completed the survey. Physicians were predominately male (67%), had received an MD degree an average of 15.1 years ago, and had spent an average of 12.8 years in practice. Twenty of the physicians (91%) were board certified in family practice, and 9% were board certified in internal medicine. Eight practices (36%) were located in communities of fewer than 25,000 persons, 4 practices (18%) were in communities of at least 25,000 but fewer than 100,000, and 10 practices (45%) were located in metropolitan areas of 100,000 or more. As the size of the community decreased, the distance to a diabetes specialist available for consultation increased, from an average of 2 miles for communities of 100,000 or more to an average of 40 miles for communities of fewer than 25,000. Two physicians reported not having a diabetes specialist in their area.

Practice size ranged from 1 to 10 physicians, with a median of 6. The physicians delivered a wide range of services: 76% practiced obstetrics, 81% provided well-child care, 90% performed minor surgery, 76% performed office fracture care, and 81% provided counseling. Of those involved in obstetric care, 39% attended 1 to 10 deliveries per year; 22%, 11 to 20 deliveries per year; 22%, 21 to 40 per year; and 17%, 41 to 60 deliveries per year.

Table 1. Frequency of Reported Consultation or Referral by Primary Care Physicians of Patients with Diabetes Complications

	% Physicians Referring, by Diabetes Complication			
Reported Frequency of Referral	Hypoglycemia with Loss of Consciousness	Diabetic Ketoacidosis	Newly Diagnosed Type I Diabetes	Type II Diabetes, Starting Insulin
Rarely (<10%)	52	56	45	71
Occasionally (10%–25%)	24	5	15	19
Sometimes (26%–74%)	10	19	15	0
Frequently (75%–90%)	0	10	5	5
Almost always (>90%)	14	10	20	5

Physicians were asked to report the average number of diabetes-related patient visits in an average month. The majority reported seeing fewer than 10 patients with type I diabetes mellitus and fewer than 20 patients with type II per month. Sixty-seven percent of physicians reported that a treatment protocol did not exist in their clinic for either type I or type II diabetes, whereas 29% had a treatment protocol for both.

Referral Patterns

Physicians were asked how frequently consultation or referral would be sought for a variety of straightforward situations: new patients with type I diabetes; new patients with type II starting insulin; patients with complications, such as diabetic ketoacidosis; and those with hypoglycemia with loss of consciousness. The frequency of referral for each situation was reported categorically: <10% (rarely), 10% to 25% (occasionally), 26% to 74% (sometimes), 75% to 90% (frequently), and >90% (almost always). Most physicians (86%) rarely referred patients with type II diabetes at the initial diagnosis, and the majority started new patients with type II on insulin without referral (Table 1). With newly diagnosed type I diabetes, there were two distinct patterns of referral, with

19% of physicians referring almost all patients (>90%), and 48% of physicians referring rarely (<10%). Some patients are co-managed by family physicians and diabetologists. In these instances, a diabetologist may manage the initial insulin therapy, and the primary care physician may manage the insulin in an ancillary manner, or not at all. Although co-management with a diabetes specialist varied among physicians, most (62%) managed almost all their patients independently (>90%).

Patient Education

Nearly all the physicians (95%) reported that they were directly involved with the diabetes education of patients, and the office nurse was involved 74% of the time. Only 44% of the clinics had access to a certified diabetes educator. Only 56% of physicians reported a direct role in dietary education, whereas 93% referred patients to a dietician for dietary education.

Patient Demographics

Seventeen of the 27 practices (63%) returned completed data sheets. One hundred five patients were identified and followed for a total of 240 patient visits (average visits per patient, 2.3). Patients not returning to the participating physician for a second or third visit within 12 months resulted in a decline in the number of patients seen at each follow-up visit. Seventeen percent of the patients had type I diabetes mellitus, 81% had type II, and 2% were not classified. The average age of patients with type I diabetes was 32 ± 13 years, with an average time since diagnosis of 12.7 years (range, 0 to 32 years). The average age of patients with type II diabetes was 66 ± 11 years, with an average time since diagnosis of 7.1 years (range, 0 to 35 years). Fifty percent of the patients with type I diabetes were female and 52% of the patients with type II diabetes were female. Just over 82% of the patients were white, and 6.3 % were black; 4.7% were Asian, 2.9% Native American, 1.9% Hispanic, and 1.9% were not identified.

Glucose Monitoring and Control

Eighty-eight percent of patients with type I diabetes performed some method of blood glucose monitoring at home; the remainder were monitored only at office visits. Of patients with type II diabetes, 60% performed blood glucose testing at home, 33% had blood glucose measured only at office visits, 3% reported testing urine glucose levels, and 4% did not monitor at all. Patients reporting no glucose monitoring had either newly diagnosed diabetes or very poor compliance.

Table 2. Assessment of Glucose Control Expressed as the Percentage of Total Visits in Which Individual Targets Were Achieved for Patients with Type I and Type II Diabetes Mellitus

Diabetes Type and Indicator	Target Identified, %	Achieved Target, %	Average Value, ±SD
Type I diabetes (n = 42)			
Glucose	79	14	196 ± 89 mg/dL
HbA_{1c}	71	2	10.0 ± 3.4%
Type II diabetes (n = 191)			
Glucose	71	20	190 ± 91 mg/dL
HbA_{1c}	60	4	8.9 ± 2.3%

The level of glucose control for patients with type I and type II diabetes mellitus was measured by determining the percentage of patients achieving their individual target level for glucose and HbA_{1c}. Since no significant differences among visits 1, 2, or 3 were found for any of the control variables, these data were combined (Table 2). Patients who could not be classified as having type I or type II diabetes were excluded (n = 7 visits). Approximately one fourth of all patients had no identified blood glucose target, and approximately one third had no identified HbA_{1c} target. Only 14% of patients with type I diabetes and 20% of patients with type II were within their glucose target. Using HbA_{1c} to assess glucose control, 98% with type I diabetes and 96% of patients with type II were not within target level range or had no identified target. The average random glucose test performed in the office was just under 200 mg/dL (11.1 mmol/L) both for patients with type I and for patients with type II diabetes. The average HbA_{1c} for patients with type I diabetes was 10.0% ± 3.4%; for patients with type II diabetes, 8.9% ± 2.3% (normal, 4.0% to 6.1%).

Therapy

Although nutrition therapy is an important part of all therapeutic interventions in diabetes mellitus, only 4% of patients with type II were treated with nutrition therapy alone. By self-report, 56% of the patients participated in some form of exercise. Table 3 reports the frequency of each treatment regimen used. The majority of patients with type I diabetes received two injections per day.

The majority of patients with type II diabetes mellitus were treated with oral hypoglycemic agents, and most of the type II patients treated with insulin received two injections per day. Similar proportions were found

Table 3. Frequency of Treatment Therapies for Patients with Type I and Type II Diabetes Mellitus

Treatment	% Patient Visits
Type I diabetes (n = 42)	
Stage 1: one-dose insulin	29
Stage 2: two-dose insulin	57
Stage 3: three-dose insulin	14
Type II diabetes (n = 191)	
Stage N: diet only	6
Stage O: oral hypoglycemics	55
Stage 1: one-dose insulin	11
Stage 2: two-dose insulin	23
Stage CT: combined therapy	5

during each subsequent visit. The majority of patients remained outside their target glucose levels without significant improvement in blood glucose or HbA_{1c} levels.

Complications

Table 4 lists the frequency of complications and comorbid conditions often associated with diabetes mellitus as reported by the physicians for patients with type I and II diabetes. Seventy-three percent of all patients with type II diabetes had at least one major complication associated with the disease. Two patients died during the data collection period, one of myocardial disease and one of liver failure.

Discussion

The concept of "translation" was introduced to the national diabetes community by the National Commission on Diabetes in 1975 as a designation for the process of accelerating adoption of new science into practice and overcoming barriers to widespread dissemination.[9]

Table 4. Percentage of Patients with Complications or Comorbid Conditions as Reported by Their Primary Care Physicians

Complication	Type I Diabetes, %	Type II Diabetes, %
Nephropathy	6	5
Retinopathy	33	8
Neuropathy	22	29
Cardiovascular (hypertension, ischemic heart disease)	39	63
Cerebrovascular	0	10
Peripheral vascular	11	10

Translation ultimately depends on the ability of primary care physicians to interpret the validity of research and balance the known risks of both disease and therapy with the overall needs of the patient.

The Diabetes Control and Complications Trial has recently demonstrated that strict glucose control significantly delays onset of microvascular complications in patients with type I diabetes mellitus and implied that strict glucose control may have a role in the prevention of complications in patients with type II diabetes as well. To weigh the cost of implementing such recommendations against the needs of the community, the characteristics of current diabetes care delivery in the primary care office must first be established.

Physicians in this study performed a wide variety of medical services, ranging from obstetrics to office fracture care. Although the study physicians were volunteers, the provision of services among these physicians, as well as their geographic distribution, closely matched those of the entire MAFPRN described in a previous study.[10] Most of the physicians assumed primary responsibility for the majority of their patients' diabetes care. As the community in which the practice was located became progressively smaller, geographic isolation from consultants and referral sources increased. Although substantial variation was demonstrated in referral patterns from physician to physician, geographic isolation itself did not account for a significant difference in the rate of referral to a diabetes specialist. Although some physicians comanaged more patients with diabetes specialists than others did, many did not refer patients with common complications of diabetes.

Almost all physicians in this study (95%) provided some diabetes education to their patients. This is consistent with a previous Pennsylvania study.[11] Although most physicians had a dietician available for patient education (93%), and two thirds of the clinics involved the office nurse in patient education, most clinics did not have access to a certified diabetes educator. This is important when we consider the desirability of a team approach for the education and management of all patients with diabetes. The lack of this ancillary support may compromise the ability of the primary care physician to implement treatment strategies aimed at improving glucose control.

It was found that most practices did not have a treatment protocol for diabetes care, despite this investigation being performed well after the initiation of the clinical education program from the ADA,[12,13] and after distribution of the guidelines for diabetes care by the Centers for Disease Control and Prevention (CDC).[14]

Few patients were found to be within target levels for glucose and HbA_{1c} set by their physicians. There are

many reasons why patients do not obtain satisfactory clinical outcomes in terms of glucose control, including poor nutrition and compliance, failure to exercise, concurrent illnesses, lack of education about diabetes (eg, desirable goals and available therapies), and family, social, and emotional problems.[15,16]

Most patients in this study were receiving diet and drug therapy. Although there is a period of time during which manipulation and adjustment of treatment is expected early in every therapeutic regimen and during which a patient will often not be under satisfactory control, persistence in this phase without achieving therapeutic goals after a satisfactory trial period usually indicates failure of the current therapy and the need to proceed to another level of therapy. There was no indication that therapy for patients in this study was intensified at subsequent visits, despite most patients not having achieved satisfactory glucose control. Although it is important to remember that not all patients with diabetes may be able to or will choose to maintain good glycemic control, the overall average HbA_{1c} was surprisingly high in this study for patients with both type I and type II diabetes mellitus.

Seventy-three percent of the patients with type II diabetes in this study had at least one major complication or comorbid condition. The most common of these was cardiovascular disease, which, among patients in this study, included both ischemic heart disease and hypertension. This is a higher rate than has been reported in other studies,[5,11] which may reflect a higher reporting rate by primary care physicians for the presence of comorbid conditions, particularly when compared with patient reports or reviews of major cardiac events.

Advanced age and presence of significant comorbid conditions are both relative contraindications to strict glucose control in type II diabetes mellitus. The frequency of complications found in this study emphasizes the inherent problems of recommending strict glucose control for many patients with type II diabetes.

The visit-based investigation format was a limitation of this study. Patient data collected from consecutive visits may be weighted toward patients who visit a physician more frequently. Initial visits may be weighted toward acute problems associated with diabetes, leading to an overestimation of the number of patients beyond control ranges. In addition, physicians taking part in the study were volunteers recruited through a research network. The degree to which this limits generalizability is difficult to measure. Although all physicians in this study had an interest in being part of ongoing practice-based research, a previous study demonstrated that members of the Minnesota Academy of Family Physicians Research Network are typical of members of the state professional association except they were more likely to be residency trained and to be practicing in rural areas.[10] Volunteer bias also should have had less effect on the laboratory-generated patient outcome measures, such as HbA_{1c}.

Translation of recommendations such as strict glucose control must be balanced against the overall needs of the patient and must work within the existing characteristics of the health care system. Most patients with diabetes are seen by physicians who spend less than 4% to 6% of their patient-directed activities in diabetes care. With mounting evidence that improved glucose control may delay or prevent diabetes complications, it is increasingly important for the primary care physician to optimize available resources to improve glucose control in patients in an effort to improve long-term clinical outcomes. Future studies are required to assess the effectiveness and the cost of clinical interventions for patients with diabetes, as well as other common chronic diseases. Networks of primary care physicians facilitating practice-based research provide a model for both investigation and integration of translational activities.

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References

1. Herman W, Sinnock P, Brenner E, Brimberry J, Langerford D, Nakashima A, et al. An epidemiological model for diabetes mellitus: incidence, prevalence and mortality. Diabetes Care 1984; 7:367–72.
2. Harris MI. Testing for blood glucose by office-based physicians in the US. Diabetes Care 1990; 13:419–26.
3. American Academy of Family Physicians. Official AAFP definition of primary care. AAFP Reporter 1975; 2(6):1.
4. McLemoe T, DeLozier J. Summary: National Ambulatory Medical Care Survey. Advance data from Vital and Health Statistics. Hyattsville, Md: National Center for Health Statistics, 1987. DHHS publication No. (PHS) 87–1250.
5. Hiss RG, ed. Diabetes in communities. Ann Arbor, Mich: University of Michigan, 1986.
6. DCCT Research Group. Diabetes control and complications trial (DCCT) update. Diabetes Care 1990; 13:427–33.

7. Bubble publishing tests and surveys: version 3.1 [computer software]. Minneapolis, Minn: Scanning Dynamics Inc, 1992.
8. Mazze R, Strock E, Etzwiler D. Staged diabetes management. International Diabetes Center, Minneapolis, Minn, 1992.
9. Hiss RG, ed. Diabetes in communities II. Ann Arbor, Mich: University of Michigan, 1992.
10. Solberg L, Cole P, Seifert M. The Minnesota Academy of Family Physicians Research Network: a vehicle for practice-based research. Minn Med 1986; 69: 599–601.
11. Jacque CHM, Jones RL, Houts P, Bauer L, Dwyer KM, Lynch JC, et al. Reported practice behaviors for medical care of patients with diabetes mellitus by primary-care physicians in Pennsylvania. Diabetes Care 1991; 14:712–7.
12. Rifkin H, ed. Physician's guide to insulin-dependent (type I) diabetes: diagnosis and treatment. Alexandria. Va: American Diabetes Association, 1988.
13. Rifkin H, ed. Physician's guide to non-insulin-dependent (type II) diabetes: diagnosis and treatment. 2nd ed. Alexandria. Va: American Diabetes Association, 1988.
14. Division of Diabetes Translation, Department of Health and Human Services, Public Health Service. The prevention and treatment of complications of diabetes mellitus: a guide for primary care practitioners. Atlanta, Ga: Centers for Disease Control and Prevention, 1991.
15. Hamburg BA, Lipsett LF, Inoff GE, Drash AL, eds. Behavioral and psychosocial issues in diabetes. Proceedings of the National Conference. US Government Printing Office, 1979. NIH publication No. 80–1993.
16. Backer TE, Liberman RP. Kuehnel TG. Dissemination and adoption of innovative psychosocial interventions. J Consult Clin Psychol 1986; 54:111–8.