Community Diabetes Care in the 1980s

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This is a study of diabetes care and care outcomes for patients under the active care of private physicians. Randomly selected communities, physicians, and patients in Michigan were the subjects of this study. Data on the care practices of physicians and patients and care outcomes were collected from 1980 to 1981 and again in 1985 from eight communities, 61 physicians, and 261 patients. We found that the use of multiple injections of insulin and self-monitoring of blood glucose increased significantly, whereas hospitalizations for diabetes control decreased. The mean glycosylated hemoglobin values for this cohort of patients remained unchanged. The study results suggest that, for patients under the active care of community physicians, modern methods of diabetes care are being implemented, but the results of improved care do not show an impact on blood glucose control as measured by glycosylated hemoglobin values. The study was not designed to establish causation for the decrease in hospitalizations for these patients, but the data suggest that decreases may be more a function of changes in health-care policies rather than changes in patient health. *Diabetes Care* 11: 519–26, 1988

The care of patients with diabetes has changed substantially during the past 10 yr as a result of research findings and improved technology. Private and federal funding for diabetes research has increased substantially. Several new treatment methods have become available such as self-monitoring of blood glucose (SMBG), new insulin preparations, and the glycosylated hemoglobin assay. Many organizations, including Diabetes Research and Training Centers, the Centers for Disease Control Diabetes Program, the American Diabetes Association, the American Association of Diabetes Educators, and the National Diabetes Information Clearinghouse, have worked diligently to facilitate the widespread dissemination of modern methods of diabetes management. It is hoped that such efforts will lead to improvements in care and health outcomes for people with diabetes. In light of these national efforts, it is necessary to document changes in diabetes care and health outcomes for patients under the active care of private physicians in the community setting. The purposes of this study by the Michigan Diabetes Research and Training Center (MDRTC) were to provide an analysis of diabetes care provided by private physicians in the community and health outcomes for their diabetic patients and to document changes in diabetes care and its outcomes in those communities during the first half of the 1980s. This was a 5-yr study; the data were collected from 1980 to 1981 and again in 1985 (1).

MATERIALS AND METHODS

This study was conducted on a randomly selected sample of communities, physicians, and people with diabetes from communities located throughout Michigan. Two types of communities were defined (large and small) based on community and hospital size and the patient care services for people with diabetes available in those communities. Thirteen communities met the criteria for large communities, and 34 communities met the criteria

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for small communities. From these, 4 large and 4 small communities were randomly selected for inclusion in this study.

In each of the four large communities, 15 primary-care physicians were randomly selected, and in each of the four small communities, 5 primary-care physicians were randomly selected. Primary-care physicians were defined as diabetologists, internists, and general and family practitioners. Pediatricians were deliberately not included because their numbers (and the number of diabetic patients cared for by them) would have been too small to be representative. The prescribed number of physicians (15 from each large and 5 from each small community) was not always obtained, because two communities did not have the requisite number of primary-care physicians and some of the randomly selected physicians declined to participate. All of the potential 19 physician collaborators in the small communities participated (100% response rate), and 42 of the potential 56 physician collaborators in the large communities participated (75% response rate). A total of 61 primary-care physicians from the eight communities participated for an overall response rate of 81%. The mean age of the physicians was 46 yr (range 28–67 yr). Seventy-five percent of the physicians were men, 56% were family or general practitioners, 38% were internists, and 6% were diabetologists.

Approximately 7 patients were selected from the patients with diabetes actively followed by each of the 61 primary-care physicians. This process was extremely difficult and required several months to accomplish. A significant problem was lack of awareness by primary-care physicians of how many patients with diabetes they were following and who these patients were. Office records are usually not codified and/or organized according to the systems used by record departments of hospitals. After several attempts to determine how many diabetic patients each primary-care physician was following, the method of having the office receptionist keep track of the names of patients with diabetes seen over a 6-mo period was adopted. From these lists, random selection of patients was accomplished. The number of patients participating from each practice varied from a low of 4 patients in one practice to a high of 10 in each of two practice settings. The median number of patients per practice was 7, and the mean was 7.02 patients per practice. All patients were under the active care of a physician and were >16 yr of age.

For confidentiality, contact with the selected patients was made by the physicians' offices through letters with postcards prepared by the MDRTC but sent out by participating physicians to their own patients. Patient agreement to participate in the study was returned to the physician who in turn notified the MDRTC. Through this process, patients both agreed to participate in a study and to have their identity known to a third party. The office nurses who compiled the list of study participants estimated patient refusals to be <10%. When a patient refused to participate the next patient on the list was invited to be in the study until approximately seven patients from each physician's office could be included. No data are available for the 10% of patients who refused to participate. Therefore, it is not known whether they differ from the patients who were studied. This method of selecting patients most likely meant that the ratio of diabetic patients studied to the total number of diabetic patients in the practice was smaller for the diabetologists. Selecting a large number of patients from the practices of diabetologists could have masked the practice behavior of the other physicians in the sample.

Patient sample. The patient recruitment process described above resulted in 428 patients agreeing to be studied. Sample size was determined by assessing the number of major outcome variables and the resources available for the study (2). From 1980 to 1981, patients were contacted and invited to attend one of several specially arranged clinics in the community at which MDRTC staff met with them to perform the study assessments. These assessments included demographic data (age, sex, general education, employment, marital status), general and diabetes-specific medical history, and physiologic data (height, weight, blood pressure, visual acuity, and amputations). Metabolic tests included fasting plasma glucose, HbA_1, serum cholesterol, high- and low-density lipoproteins, triglycerides, and creatinine. Patients also completed a diet history, a standardized diabetes knowledge test, an assessment of health habits and diabetes self-care behavior, psychosocial adjustment measures, and a health-care services–utilization survey. Approximately 25% of the patients required home visits for reasons such as transportation, logistics, and infirmity. All biochemical assessments on patients were performed in the core laboratories of the MDRTC. Data were entered into a large relational data-base management system, which facilitated subsequent analyses with various statistical packages.

The data collection was repeated in 1985; 261 (61%) of the patients studied in 1981 were successfully located and reexamined. In addition, in 1985, stimulated C-peptide and reading level were assessed. Data from these 261 patients were used to answer the epidemiological questions regarding changes in treatment, health status, care practices, and hospitalizations posed for this study. Of the 167 patients not restudied, 65 had died, 31 had moved, 30 refused to participate again, 29 were too sick or infirm, 3 claimed they no longer had diabetes, and 9 patients who agreed to be studied repeatedly failed to show up for appointments.

Because a substantial number of patients were lost to follow-up due to death or other reasons, a comparison of baseline data (1980–1981) among the groups of patients who *1*) were restudied, *2*) had died, or *3*) were lost to follow-up but not known to have died was carried out (Table 1). The patients who had died were older, had diabetes of longer duration, and had a higher age at onset. Also, they had had more heart attacks and strokes. Finally, the patients who died had the smallest percentage of insulin-dependent diabetes mellitus

TABLE 1
Differences in 1980–1981 among the 428 patients who were restudied, lost to follow-up, or who had died

Variable	Restudied (n = 261)	Lost (n = 102)	Died (n = 65)	Restudied vs. lost (P)	Restudied vs. died (P)	Lost vs. died (P)
Mean age (yr)	57	51	66	≤.001	≤.001	≤.001
Mean age at onset (yr)	47	40	52	≤.001	≤.03	≤.001
Mean duration of diabetes (yr)	11	12	15	NS	≤.003	≤.05
Mean HbA_1 (%)	9.5	10.4	9.6	≤.001	NS	≤.03
Experienced heart attacks (%)	16	12	28	NS	≤.03	≤.009
Experienced strokes (%)	8	6	17	NS	≤.02	≤.02
Hospitalized for diabetes (%)	26	33	37	NS	NS	NS
Patients with IDDM (%)	11	25	5	≤.001	NS	≤.001
NIDDM patients taking insulin (%)	46	57	63	NS	≤.04	NS
Systolic blood pressure >140 mmHg (%)	27	29	40	NS	≤.04	NS
Diastolic blood pressure >90 mmHg (%)	8	15	12	NS	NS	NS

*Percentages are based on total number of patients in this category.

(IDDM) and the largest percentage of non-insulin-dependent diabetes mellitus (NIDDM) using insulin. These data suggest that they were a sicker group of patients. The patients lost to follow-up but not known to have died tended to be younger with an earlier age of onset and to have a high proportion of IDDM. Their relative youth may be related to the number of them having moved. Although there were statistical differences among the three groups in level of HbA_1, it is doubtful that the differences are large enough to be clinically meaningful. On examination there was only one difference among the three groups regarding blood pressure; i.e., 40% of the patients who died had a high systolic blood pressure compared to 27% of the patients who were restudied. There were no differences among the three groups regarding sex, percentage of ideal body weight, cholesterol levels, percentage of patients who smoked, or percentage of diabetes-related hospital admissions in the past 2 yr.

The classification of type of diabetes for some patients was changed based on stimulated C-peptide data obtained in the 1985 study. Patients with 1-h stimulated C-peptide values <0.6 ng/dl were classified as having IDDM. In addition, 33 NIDDM patients had a change in their insulin-taking program from 1981 to 1985, with 28 patients starting insulin in the interval and 5 patients discontinuing insulin use. To compare a matched cohort of patients, categorization by type of diabetes and use of insulin was made for both 1981 and 1985 data collections based on patient status in 1985.

Statistical analysis of major variables was done with the Michigan Interactive Data Analysis System (MIDAS) maintained by the Statistical Research Laboratory of the University of Michigan. Data were of several types: interval data on a constant scale such as glycosylated hemoglobin, nominal data in which each patient belonged to one category or another at each time period, or data that recorded the existence or frequency of an event (e.g., hospitalization) in the period before data collection. Interval data were analyzed with a dependent t test, and nominal data were analyzed with a χ^2-test. Event frequencies were analyzed in two separate ways. A comparison of the number of affected patients during each time period was made with χ^2. The rate or frequency of the event in the total group during each period was compared via parametric tests. In each analysis of this type the P values of the parametric and nonparametric test were similar. For those parameters that did not undergo a statistically significant ($P \leq .05$) change and are not shown in tables, the 1985 values are reported.

RESULTS

Demographics. The demographic data presented here are for 1985. The sample (n = 261) of patients who were restudied consisted of 98 (38%) men and 163 (62%) women under the active care of private physicians in communities in Michigan (Table 2). The mean age of men was 61 yr, and the mean age of women was 62 yr. Forty-seven (18%) of the patients had IDDM, 112 (43%) patients had NIDDM and were using insulin, and 102 (39%) patients had NIDDM and were not using insulin.

Biologic and morbidity factors. Percentage of ideal body weight and glycosylated hemoglobin values remained unchanged, whereas total cholesterol increased for the entire sample but remained in the normal range (Table 3). Mean high- and low-density lipoproteins remained in the normal range during both assessments. Mean creatinine levels were also in the normal range both times, but 44 individuals developed abnormal creatinine levels between 1981 and 1985.

The hypertension data have nine missing cases, leaving a sample of 252 patients (Table 4). Patients were classified as having hypertension if they reported that a doctor told them that they had high blood pressure. The prevalence of hypertension did not change. The per-

TABLE 2
Demographic data 1985

Age (yr)	
Men	61 (22–84)
Women	62 (23–89)
Sex	
Men	98 (38%)*
Women	163 (62%)
Type of diabetes	
IDDM†	47 (18%)
NIDDM taking insulin‡	112 (43%)
NIDDM not taking insulin‡	102 (39%)
Age at diagnosis of diabetes (yr)	
IDDM	25 (3–63)
NIDDM taking insulin	50 (23–76)
NIDDM not taking insulin	55 (26–82)
Duration of diabetes (yr)	
IDDM	21 (5–58)
NIDDM taking insulin	16 (5–50)
NIDDM not taking insulin	11 (5–30)

Values for age, age at diagnosis, and duration of diabetes are means with ranges indicated in parentheses; $n = 261$.
*All percents are column percents unless otherwise noted.
†Based on 1-h stimulated C-peptide values <0.6 ng/dl performed in 1985.
‡Based on 1985 status of insulin usage.

centage of patients with a diagnosis of hypertension who reported being under treatment for the disorder was 92% in 1981 and decreased to 85% in 1985. In 1985, 92% of the hypertensive patients reported they were taking antihypertensive medication; 71% had been advised to lose weight, with 54% being given weight-reduction guidelines. Also, 72% of the hypertensive patients had been advised to restrict salt intake, but only 37% had been given salt-restriction guidelines. Finally, 49% of the hypertensive patients had been told to exercise, but only 20% had been given exercise guidelines. The only significant change in treatment modality was the increase in the number of patients told to exercise. On examination, 5.4% of the patients in the entire sample had a diastolic pressure >90 mmHg. There was no significant difference between the percentage of patients in the sample under treatment for hypertension who had a diastolic pressure >90 mmHg (6.2%) and the remaining patients in the sample with a diastolic pressure >90 mmHg (4.8%).

In 1981, of the 261 patients restudied, 42 patients reported having had a heart attack, 20 patients reported strokes, 9 were blind, and 5 had had amputations. In 1985, the totals increased; 52 patients reported having had heart attacks, 27 patients reported strokes, 11 patients were blind, and 8 had had amputations.

Diabetes-care practices. As stated earlier, to ensure a matched cohort of patients, type of diabetes and insulin use were established based on 1985 data (Table 2). Table 5, which describes insulin use, is the only exception to this decision and contains the actual 1981 and 1985 insulin use data. In 1981 there were 84 NIDDM patients using insulin, and in 1985 there were 112 NIDDM patients using insulin.

There were changes in the way that insulin was administered during the study period. The percentage of both IDDM and NIDDM patients who took two or more injections of insulin per day increased. The type of insulin used did not change. Glucose-monitoring practices changed significantly during the study period (Table 5). The reported use of urine testing declined across all groups of patients. There was a concomitant rise in the reported frequency of SMBG.

To determine whether there was a relationship between intensity of insulin regimen and mean HbA_1, several analyses were conducted on the insulin-using patients in 1985 ($n = 159$). For the first analysis the patients

TABLE 3
Metabolic indices

	1981 ($n = 261$)	1985 ($n = 261$)
Percent ideal body weight (mean percent)		
Men		
IDDM	102	107
NIDDM taking insulin	131	127
NIDDM not taking insulin	116	113
Women		
IDDM	114	117
NIDDM taking insulin	161	158
NIDDM not taking insulin	152	151
HbA_1*		
IDDM	10.8 (6.4–16.5)	10.4 (7.6–13.0)
NIDDM taking insulin	9.9 (6.1–15.8)	9.9 (5.8–17.0)
NIDDM not taking insulin	8.5 (6.1–16.4)	8.6 (6.0–13.2)

P NS for all indices.
*Values are means with ranges indicated in parentheses. Normal range 6.0–8.5%.

TABLE 4
Hypertension

	1981*	1985*	*P*
Patients with hypertension	152 (60%)†	168 (67%)†	NS
Patients being treated for hypertension	140 (92%)‡	142 (85%)‡	≤.05
Treatment programs	$n = 140$	$n = 142$	NS
Patients taking antihypertensives	127 (91%)§	131 (92%)§	NS
Weight-reduction program	95 (68%)	101 (71%)	NS
Guidelines given	66 (47%)	76 (54%)	NS
Salt restriction	104 (74%)	106 (72%)	NS
Guidelines given	43 (31%)	52 (37%)	NS
Exercise program	50 (36%)	70 (49%)	≤.02
Guidelines given	13 (9%)	29 (20%)	NS

*There are 9 missing cases for hypertension data; $n = 252$.
†Percentage of patients with diagnosis of hypertension.
‡Percentage of patients with diagnosis of hypertension who were being treated.
§Percentage of patients utilizing particular treatments.

TABLE 5
Self-care practices

	1981 (n = 261)	1985 (n = 261)	P
Insulin injection frequency			
IDDM			
Once daily	24 (50%)*	14 (30%)*	≤.03
Twice or more	23 (50%)	33 (70%)	
NIDDM taking insulin			
Once daily	62 (74%)†	64 (57%)	≤.02
Twice or more	22 (26%)	48 (43%)	
Glucose-monitoring practices			
Patients told to test urine			
IDDM	40 (85%)‡	16 (19%)‡	≤.001
NIDDM taking insulin	71 (63%)	20 (18%)	≤.001
NIDDM not taking insulin	23 (23%)	6 (6%)	≤.001
Patients told to monitor blood glucose			
IDDM	11 (23%)‡	33 (70%)‡	≤.001
NIDDM taking insulin	5 (4%)	43 (38%)	≤.001
NIDDM not taking insulin	1 (1%)	22 (22%)	≤.001

*Column percent for type of diabetes.
†In this study, assignment of diabetes type and insulin usage was based on 1985 status of each patient; these data are the one exception to that rule and show the actual number of NIDDM patients using insulin in 1981, which was 84.
‡Percentages are based on total number of patients in this category.

were divided into four groups: patients using *1*) multiple injections of insulin and SMBG, *2*) multiple injections and no SMBG, *3*) single injections and SMBG, and *4*) single injections and no SMBG. There were no differences in mean HbA_1 levels among the four groups. Next, the 76 patients who were practicing SMBG were divided into four groups and compared: *1*) adjusts insulin and takes multiple injections, *2*) adjusts insulin and takes one injection, *3*) does not adjust insulin and takes multiple injections, and *4*) does not adjust insulin or take multiple injections. Again there were no differences in mean HbA_1 among the four groups. Finally, the mean HbA_1 levels of the 19 patients who used SMBG and multiple injections, and who adjusted their own insulin, were compared to the HbA_1 levels of the remaining insulin-using patients. No differences were found.

Sixty-five percent of patients reported being instructed to care for their feet during both study periods. Ninety-two percent of those instructed to care for their feet reported that they inspected them more than once a week. Exercise prescriptions for IDDM patients remained unchanged, with 32% of patients being instructed to exercise. The percentage of NIDDM patients receiving exercise prescriptions increased ($P \leq .03$) from 31 to 43%. One hundred thirty-eight (53%) patients reported ever having smoked cigarettes, with 52 (20%) current smokers in 1981 and 42 (16%) current smokers in 1985. There was relatively little change in the percentage of patients who wore or carried diabetic identification; it stayed at 89% for IDDM patients and at 32% for non-insulin-using NIDDM patients. There was a significant increase, from 67 to 80% ($P \leq .02$), in the insulin-using NIDDM patients carrying diabetic identification.

There was an increase in the self-report of mean number of calories consumed per day by the entire sample from ~1500 in 1981 to ~1600 in 1985 ($P \leq .01$). Additional analyses showed a significant increase in caloric intake for only one category of patients—women with NIDDM.

There was a significant increase in the percentage of insulin-using patients who reported having a good understanding of diabetes (Table 6). For IDDM patients the increase was from 72 to 96%; for NIDDM patients on insulin the increase was from 61 to 78%. The increase in the number of patients who reported having a good understanding of diabetes was not matched by an increase in scores on a standardized diabetes knowledge test given to all patients in both 1981 and 1985. The total mean percentage correct stayed almost the same across all three patient groups: IDDM patients had 73% correct, NIDDM patients on insulin had 59% correct, and NIDDM patients not on insulin had 51% correct. In fact, the only significant change ($P \leq .01$) in test scores was a decrease in the scores of IDDM patients on the questions related to blood glucose from 93% correct in 1981 to 86% correct in 1985. There was a significant difference ($P \leq .001$) between the mean percentage correct on the knowledge test for patients who reported having attended a formal patient-education program (62%) and those patients who did not (54%).

Utilization of health-care services. There were changes in the number and ratio of diabetes-related hospital admissions during the study period (Table 7). The number

TABLE 6
Patient knowledge of diabetes

	1981 (n = 261)	1985 (n = 261)	P
Patients reporting good understanding of diabetes			
IDDM	34 (72%)*	45 (96%)*	≤.002
NIDDM taking insulin	68 (61%)	87 (78%)	≤.008
NIDDM not taking insulin	53 (52%)	66 (65%)	NS
Knowledge test scores (mean)			
IDDM	72%	73%	NS
NIDDM taking insulin	58%	59%	NS
NIDDM not taking insulin	51%	51%	NS

*Percentages are based on total number of patients in this category.

of patients in this cohort reporting diabetes-related hospitalizations (in the 2 previous yr) decreased from 69 in 1981 to 44 in 1985. Also, the number of diabetes-related hospital admissions for the entire sample decreased from 129 reported in 1981 to 76 reported in 1985 (only 2 of the 1981 admissions for IDDM patients were the so-called "initial" hospitalizations at time of diagnosis). Much of this decrease is accounted for by IDDM patients who had 46 admissions in the 2 yr preceding 1981 and only 10 admissions in the 2 yr preceding 1985. The NIDDM patients experienced little change in their incidence of diabetes-related hospital admissions during the study period. The incidence of hospitalizations for diabetes control decreased significantly. The incidence of hospitalizations for other diabetes-related problems such as ketoacidosis, foot problems, heart disease, kidney disease, and visual problems remained unchanged.

Visits to the physicians' offices declined significantly ($P \leq .02$) for IDDM patients from an average of 14 visits during the 2-yr period before 1981 to an average of 8 visits for the 2-yr period before 1985. NIDDM patients on insulin visited their physicians an average of 10 times in the 2-yr period; for NIDDM patients not on insulin the average was 8 times. There was no change in the number of patients who had ever been seen by an ophthalmologist for diabetes-related evaluation. Eighty-one percent of the IDDM patients and 54% of the NIDDM patients reported ever visiting an ophthalmologist. The percentage of patients who reported having been seen by an ophthalmologist in the past 2 yr was 68% for IDDM patients and 51% for NIDDM patients. The ratio of patients ever seeing an ophthalmologist to those seeing one in the past 2 yr did not change significantly during the study.

DISCUSSION

There have been substantial changes in the methods of diabetes care available during the last 10 yr, with a concurrent national effort to disseminate that care technology and promote its use. Although this study does not establish causation for change, it demonstrates that desired and expected changes in diabetes care have occurred. The study period was too short to register long-term changes in health outcomes, but these results indicate several significant changes in health-care practices.

Demographics. This study, although indicating changes that have national relevance, focuses on a select group of patients, i.e., those under the active care of private physicians in Michigan communities. There are important differences between the sample of patients in this study and the total population of people in the United States with diabetes. For example, this sample did not include patients who were under the care of government

TABLE 7
Diabetes-related hospital admissions during the previous 2 yr

	1981			1985		
	Number of patients admitted	Total number of admissions	2-yr* admission rate	Number of patients admitted	Total number of admissions	2-yr* admission rate
Patient category						
All patients (n = 261)†	69	129	0.49	44	76	0.29
IDDM (n = 47)†	20	46	0.98	8	10	0.21
NIDDM taking insulin (n = 112)	40	70	0.63	30	56	0.50
NIDDM not taking insulin (n = 102)	9	13	0.13	6	10	0.10
Admission diagnosis						
Diabetes control†	49	66	0.25	24	29	0.11
Ketoacidosis	4	4	0.02	3	3	0.01
Foot problems	2	3	0.01	6	7	0.03
Heart disease	8	13	0.05	10	17	0.07
Kidney disease	4	9	0.03	2	2	0.01
Visual problems	5	7	0.03	2	2	0.01

*The 2-yr admission rate is the number of total admissions divided by the number of patients.
†$P \leq .01$.

institutions, such as community clinics and Veterans Administration hospitals, or those institutionalized or living in very large cities. Also the sample did not include those people with diabetes who were not under active care by a physician, which may mean the patients in this sample were more likely to have complications. The mean age at diagnosis for patients with IDDM was 25 yr, which indicates that most of the patients in this study developed diabetes as adults. A possible explanation for this finding is that the majority of patients who develop diabetes as children receive diabetes care from diabetologists when they become adults. Because diabetologists have a much larger portion of their practice devoted to patients with diabetes than do other primary-care physicians, sampling equal numbers of diabetic patients from each study physician's practice will underrepresent the contribution of diabetologists to overall diabetes care and miss most patients with childhood-onset diabetes.

Sixty-two percent of the patients studied were women, and 38% were men. There are more diabetic women in the United States than diabetic men (3), but it is difficult to compare this ratio to national data because the incidence of diabetes in men versus women varies by age and race. Eighteen percent of the patients in the sample were classified as having IDDM; this is higher than the 5–10% prevalence estimates for the population of all people with diabetes (3). Very little is known about the prevalence of NIDDM in adults because of the difficulties in classifying this type of diabetes in adults (3). Because the C-peptide assay was used in this study to classify patients and because the mean disease duration for the patients with IDDM was 21 yr, some of the patients now classified as having IDDM probably started out with NIDDM and lost β-cell function over the course of their disease.

The patients classified as having NIDDM are split almost equally between patients who are treated with insulin and those who are not treated with insulin. The percent of NIDDM patients using insulin is substantially higher than national figures (3) and suggests that patients treated with insulin may have visited their physicians more often than NIDDM patients not treated with insulin, and as a consequence they were more likely to be included in the study.

Biologic factors. The lack of change of mean HbA_1 and percentage of ideal body weight for any of the three patient groups (IDDM, NIDDM on insulin, NIDDM not on insulin) may indicate that the improvements in care practices between the two study periods have not been of sufficient potency to result in a concurrent improvement in aggregate metabolic status. The worsening of serum creatinine values for 44 individuals reflects the natural history of various types of renal disease in a general diabetic population. The rise in mean cholesterol values could be anticipated, at least partly, from the 5-yr increase in age.

Most of the patients in this study had normal blood pressure on examination. The data indicate that many of the hypertensive patients had been advised to lose weight, restrict salt, and exercise, but that relatively few of those patients had been provided with guidelines for doing so. This may be because physicians are pessimistic about the likelihood of patients following recommendations to lose weight and/or exercise because the hypertension was being well controlled with medication in most patients.

Diabetes-care practices. The study suggests physicians are employing more complex insulin regimens now than in 1980 to 1981 and that physicians and patients are relying more on SMBG and less on urine testing for diabetes care. One must be cautious about making comparisons about the efficacy of different approaches to treatment (e.g., 1 vs. multiple injections of insulin) based on the data in this study, because patients have not been randomly assigned to different treatment conditions. These data do indicate that modern treatment methods are being employed more frequently at the community level. Although one could argue that more change is still needed, the movement indicated by this study is in the right direction. It appears that community physicians and patients are more successful in initiating technological changes than life-style changes.

Smoking among this sample of patients is somewhat below the national average (4) (~30% of adults) and is relatively stable. Eighty to ninety percent of the insulin-using patients wear or carry diabetic identification, a good compliance rate for this treatment recommendation.

Although the percentage of patients in all groups who reported having a good understanding of diabetes rose significantly, their scores on written knowledge tests remained stable except in one instance where there was a decline. The patients' perception of their understanding seems somewhat stronger than the evidence warrants. One possible explanation is that patients may have different criteria than diabetes educators for what constitutes good understanding of diabetes. Also, it is possible that 5 more yr of diabetes self-care contributed to a perception that they understood their diabetes well. However this perception occurred, it is not supported by the evidence provided by the diabetes knowledge tests. Finally, there is a significant association between having attended a formal patient-education program and getting a higher score on the knowledge test. This is probably due to both the impact of the education and the likelihood of patients with complex regimens (which require more knowledge) being referred to formal patient-education programs.

Health-care utilization. The patients in this study reported a significant decrease in diabetes hospitalizations. Self-report of diabetes-related hospitalizations has been found to produce reliable data (5). The decrease was so marked that the 1981 data were checked by hand to determine how many 1981 hospitalizations were related to a new diagnosis of diabetes, because this cause of admission would not be present in 1985. Only 2 of 129 hospitalizations in 1981 were related to an initial

diagnosis of diabetes. The change in number of diabetes-related hospitalizations probably represents changes in health-care practices rather than changes in health. This conclusion is supported both by the lack of evidence of improved health in the biologic data and by changes in the health-care system (e.g., diagnosis-related groups, preadmission authorization requirements, utilization review procedures, and the practice of starting patients on insulin in outpatient settings that was encouraged in MDRTC outreach communities). The results of this study emphasize the need to account for national or regional trends in the utilization of health-care services during evaluation of the impact of interventions on hospitalization rates.

There was a slight decrease in the mean number of patient visits to the physician. The overall average for all patients in 1985 was ~4 visits/year. There are probably several reasons for this decrease, which are not assessed in this study. The percentage of patients seen, ever or recently, by an ophthalmologist remained unchanged and indicates that a major national recommendation concerning diabetes care is either being unheard or unheeded, or, as is indicated by another study (6), many patients live far enough from an ophthalmologist to decrease the likelihood of them visiting one.

Changes in care versus outcome. This study indicates that new approaches to the treatment of diabetes are being implemented by private physicians and their patients at the community level, but that more change is required. The study also indicates that for this cohort of patients the changes in diabetes care are not yet reflected in the biologic outcomes used to measure the impact of diabetes and diabetes care. There are at least three reasons that may account for this finding. First, the study time is too short to register biologic impact on some of the outcomes of interest, such as the rate of long-term complications, although that is not the case with glycosylated hemoglobin values. Second, although much technological progress has been made in the treatment of diabetes, the improvements in diabetes care may not yet be powerful enough to effect significant metabolic improvements for patients receiving routine care in the community. Finally, the self-care of diabetes often requires significant change in the life-style behavior of patients, and the ability of the health-care system to effect behavioral change in patients is currently modest.

Unlike most clinical studies that are carried out at major medical centers or in camp settings, this was a randomized study of diabetic patients under the active care of private community-based physicians. As such, it offers a useful description of diabetes care and care outcomes for diabetic patients under the active care of private physicians.

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