

Adherence to Guidelines for Youths With Diabetes Mellitus

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KEY WORDS

quality of care, children and youths, diabetes mellitus

ABBREVIATIONS

HbA1c—hemoglobin A1c

ADA—American Diabetes Association

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WHAT'S KNOWN ON THIS SUBJECT: Although children and youths with diabetes mellitus are at increased risk for long-term complications associated with disease duration, evidence suggests that the quality of care for children and youths with diabetes is less than ideal.



WHAT THIS STUDY ADDS: The findings of this study add evidence supporting the need to assist youths with chronic health conditions as they transition to adulthood and adult health care.

abstract



OBJECTIVE: To describe demographic and clinical characteristics associated with self-reported receipt of tests and measurements recommended by the American Diabetes Association (ADA) for children and youths with diabetes.

METHODS: The study included 1514 SEARCH for Diabetes in Youth study participants who completed a survey about diabetes care received. Quality-of-care measures were based on ADA guidelines for eye examinations and glycohemoglobin (hemoglobin A1c [HbA1c]), lipid level, microalbuminuria, and blood pressure measurements, and a composite variable of these 5 indicators was created. Multivariate logistic regression models were used to assess the association of selected demographic and clinical characteristics with the reported receipt of all recommended tests and measurements according to age and diabetes type subgroups.

RESULTS: Overall, 95% of the participants reported having their blood pressure checked at all or most visits, 88% had lipid levels measured, 83% had kidney function tested, 68% underwent HbA1c testing, and 66% underwent an eye examination, in accordance with ADA recommendations. Participants aged 18 years or older, particularly those with type 2 diabetes, tended to have fewer tests of all kinds performed. Age and family income emerged as important correlates of overall quality of care in multivariate models; older age and lower income were associated with not meeting guidelines.

CONCLUSIONS: Although there was relatively good adherence to ADA-recommended guidelines for most indicators, efforts are needed to improve rates of HbA1c testing and eye examinations, particularly among older youths. *Pediatrics* 2011;128:531–538

Although children and youths with diabetes mellitus are at increased risk for long-term complications associated with disease duration,^{1,2} evidence suggests that the quality of care for children and youths with diabetes is less than ideal. Low rates of glycohemoglobin (hemoglobin A1c [HbA1c]) testing and ophthalmologic assessments have been reported, as well as inadequate glycemic control and treatment of dyslipidemia.^{3–6} The assessment of quality and outcomes of health care for children has lagged behind that of adults in the United States for a variety of reasons, including the lack of a strong “business case” for quality assessment of children’s health care, competing demands for funds, fewer trained investigators, and fewer measures designed specifically to study quality of care for children.^{7–10} Methodologic issues also pose challenges for the assessment of children’s quality of diabetes care, including age-specific requirements for optimal diabetes treatment^{10,11} and different measures of care quality for type 1 and type 2 diabetes, reflecting the apparent etiologic and physiologic differences between diabetes types.¹¹ Finally, although diabetes is among the most common chronic illness among children and youths, the number of youths with diabetes in any given geographic area or health care facility is fairly small.

The SEARCH for Diabetes in Youth study, a multicenter, population-based study of children and youths with diabetes, provides a unique opportunity to measure the quality of care received by a large diverse sample of young people with diabetes throughout the United States. We evaluated the self-reported quality of care received by youths in this study by using the American Diabetes Association (ADA) guidelines for diabetes care,¹¹ and we assessed the association of sociode-

mographic and clinical factors with receiving recommended processes of care for diabetes.

METHODS

SEARCH for Diabetes in Youth Study Procedures

The SEARCH for Diabetes in Youth study began population-based ascertainment of youths with clinically diagnosed diabetes who were younger than 20 years in 2001 (prevalence) and youths with newly diagnosed diabetes (incidence) beginning in 2002 and continuing through the present.¹² Briefly, cases of diabetes were identified in 4 geographically defined populations in Ohio, Colorado, South Carolina, and Washington, among Indian Health Service beneficiaries from 4 American Indian populations, and among enrollees in several health care plans in California and Hawaii. The institutional review boards for all sites approved the study protocol. Youths identified as having diabetes were then invited to participate in an in-person visit, where informed consent was obtained; physical measurements and fasting blood samples were obtained from participants in metabolically stable condition, and questionnaires were administered.¹² Participants whose diabetes onset occurred in 2002–2005 (incident cases) also were invited to follow-up visits at 12, 24, and 60 months after the baseline visit.

Quality-of-Care Survey

The SEARCH for Diabetes in Youth study survey on quality of care was designed to solicit information about conformity with ADA-recommended standards of diabetes care, access to care, self-care practices, and satisfaction with care. Two versions of the survey were created, 1 for participants aged 18 years or older at the time of the survey, to be completed by the participant, and 1 for participants younger than 18 years, to

be completed by the participant’s parent or guardian. All surveys were conducted in English or Spanish.

Study Population

The quality-of-care survey was administered to 2 groups of SEARCH for Diabetes in Youth study participants. The first group was composed of youths whose diabetes was incident in 2002–2005 and who had completed a follow-up visit. Surveys were administered to participants (or parents/guardians for children younger than 18 years) at the 24-month follow-up study visit ($N = 963$). In this group, 912 participants (95%) completed the quality-of-care survey. The second group of participants consisted of youths whose diabetes was prevalent in 2001 and who had completed a baseline study visit ($N = 2534$). Of those participants, a sample was selected for the quality-of-care survey in 2008, including all youths from racial and ethnic minority groups ($N = 770$) and a 10% random sample of non-Hispanic white youths ($N = 174$). Surveys for the second group were completed by mail, over the telephone, or via an Internet-based survey application, between September 2008 and March 2009. Of the 944 participants selected to participate in the prevalent diabetes survey, 613 (65%) completed the survey. This sampling strategy yielded a total sample size of 1525 youths with type 1 or type 2 diabetes and ensured broad ranges of age, race/ethnicity, and duration of diabetes, which all are potentially related to the quality of care received.

Quality-of-Care Measures

Dependent variables used in these analyses were self-reported receipt of 5 specific, diabetes-related, processes of care, namely, HbA1c and lipid testing, blood pressure measurement, assessment of microalbuminuria, and dilated eye examination. These pro-

cesses of care are based on ADA guidelines for diabetes care, with specific requirements depending on age, diabetes type and duration, and medication regimen.¹¹ For the purposes of this study, the 5 processes were defined as follows: (1) HbA1c testing: ≥ 3 times per year if the patient was receiving insulin or ≥ 2 times per year if the patient was not receiving insulin; (2) blood pressure measurement: at most physician visits for all patients; (3) eye examination: at least once in the past year for patients with type 1 diabetes who were ≥ 10 years of age and had diabetes duration of ≥ 5 years and for all patients with type 2 diabetes; (4) lipid level measurement: at least once ever for patients 12 to 17 years of age and at least once in the past year for patients aged 18 years or older; (5) microalbuminuria measurement: at least once in the past year for patients with type 2 diabetes and for patients with type 1 diabetes who were 10 years of age or older and had diabetes duration of ≥ 5 years. Receipt of these tests/measurements was assessed through responses to questions in the SEARCH for Diabetes in Youth study quality-of-care survey (Appendix).

To measure the association of demographic and clinical factors with the overall quality of care received, we constructed a dichotomous quality-of-care summary indicator. The value of this summary indicator was calculated by first determining which of the 5 ADA-recommended tests each participant should have received on the basis of his or her age, diabetes type, and diabetes duration. The summary indicator was assigned a value of 1 if the participant had received all recommended tests, and it was assigned a value of 0 if the participant had not received all of the recommended tests. In this way, we were able to take into account differences in ADA test recommendations among our diverse group

of children and youths and to assess the overall processes of care received. Covariates used in the analyses, including gender, race/ethnicity, diabetes type (determined on the basis of health care providers' reports), and other demographic characteristics were derived from information collected at the time of enrollment into the study. Age and diabetes duration were calculated as of the date of survey completion. Information regarding care provider specialty, type of health insurance, and continuous insurance coverage was collected as part of the quality-of-care surveys.

Statistical Analyses

Of the 1525 participants who completed a quality-of-care survey, 10 did not have type 1 or type 2 diabetes and were excluded. One respondent's age could not be calculated and that respondent was excluded, which left 1514 youths and young adults with diabetes available for this analysis. We calculated the proportion of respondents who had received each of the 5 individual tests, including only participants who met the criteria for each test. Respondents who answered "do not know/not sure" were excluded from these analyses, because it could not be determined whether they had received the test.

Because of the high correlation of age and diabetes type, these analyses were stratified according to diabetes type and age (ie, type 1 and 3–11 years of age, type 1 and 12–17 years of age, type 1 and 18 years of age or older, type 2 and 12–17 years of age, or type 2 and 18 years of age or older). The χ^2 statistic was used to determine the significance of differences between these age/type groups and also among age groups within diabetes type. *P* values of $< .05$ were considered significant.

The associations between quality of care and selected demographic and

clinical characteristics were assessed by using logistic regression models with the quality-of-care summary variable described above as the dependent variable. Anticipating that demographic and clinical factors might have different associations with the quality of care received by participants in different age groups, we stratified these multivariate analyses. Separate models were constructed for the entire sample and for ages 3 to 11, 12 to 17, and 18 years or older. All 4 models included the variables of gender, race/ethnicity, family composition (1- vs 2-parent household), family income, type of health insurance, continuous insurance during the previous 12 months, and diabetes care provider specialty. The model for the entire sample also was adjusted for age group. Duration of diabetes was included in preliminary models (data not shown) but was excluded from the final models because it was consistently nonsignificant. All models included the SEARCH for Diabetes in Youth study center, to adjust for any potential differences associated with study sites.

The analyses using the dichotomous quality-of-care summary variable excluded cases that were missing data for any test recommended on the basis of ADA criteria. Of the 1514 cases in the first part of the analysis, 1212 (80%) had complete data for all recommended tests. An additional 125 cases were excluded from the multivariate models because of missing covariate data, which resulted in 1087 cases (72% of our original sample) being included in these analyses. All analyses were performed with SAS 9.2 (SAS Institute, Inc, Cary, NC).

RESULTS

Of the 1514 youths who completed the quality-of-care survey, 85% had type 1 diabetes, 53% were female, and 84%

TABLE 1 Sociodemographic and Clinical Characteristics of the SEARCH for Diabetes in Youth Study Quality-of-Care Survey Sample, According to Diabetes Type and Age

Characteristic	Type 1 Diabetes			Type 2 Diabetes		Total
	3–11 y	12–17 y	≥18 y	12–17 y	≥18 y	
<i>N</i>	392	533	363	74	152	1514
Age, mean ± SD, y	8.9 ± 2.2	15.2 ± 1.7	21.2 ± 2.3	15.8 ± 1.5	21.9 ± 2.5	15.7 ± 5.2
Gender, <i>n</i> (%)						
Female	201 (51)	270 (51)	182 (50)	50 (68)	97 (64)	800 (53)
Male	191 (49)	263 (49)	181 (40)	24 (32)	55 (36)	714 (47)
Race/ethnicity, <i>n</i> (%)						
Non-Hispanic white	278 (71)	292 (55)	131 (36)	11 (15)	10 (7)	722 (48)
Black	39 (10)	89 (17)	76 (21)	35 (47)	66 (43)	305 (20)
Hispanic	46 (12)	110 (21)	114 (31)	20 (27)	29 (19)	319 (21)
Other	29 (7)	42 (8)	42 (12)	8 (11)	47 (31)	168 (11)
Annual family income, <i>n</i> (%)						
Below \$25 000	49 (13)	91 (17)	57 (17)	27 (36)	56 (38)	280 (19)
\$25 000–\$49 000	67 (17)	90 (17)	61 (18)	22 (30)	30 (20)	270 (18)
\$50 000–\$74 000	78 (20)	102 (19)	44 (13)	7 (9)	5 (3)	236 (16)
Above \$75 000	175 (46)	213 (40)	68 (20)	4 (5)	10 (7)	470 (32)
Do not know/refused to answer	15 (4)	31 (6)	112 (33)	14 (19)	48 (32)	220 (15)
Family composition, <i>n</i> (%)						
1-parent household	74 (19)	156 (31)	123 (37)	49 (71)	72 (56)	474 (33)
2-parent household	311 (81)	350 (69)	207 (63)	20 (29)	56 (44)	944 (67)
Type of insurance, <i>n</i> (%)						
Private	296 (77)	401 (76)	214 (60)	29 (40)	59 (39)	999 (67)
Medicaid/Medicare	79 (20)	113 (21)	66 (19)	41 (56)	47 (31)	346 (23)
Other	7 (2)	6 (1)	44 (12)	2 (3)	16 (11)	75 (5)
None	4 (1)	8 (2)	32 (9)	1 (1)	28 (19)	73 (5)
Continuously insured in past 12 mo, <i>n</i> (%)						
No	17 (4)	25 (5)	59 (16)	9 (12)	48 (32)	158 (11)
Yes	370 (96)	498 (95)	300 (84)	64 (88)	103 (68)	1335 (89)
Diabetes care provider, <i>n</i> (%)						
Pediatric endocrinologist	270 (70)	385 (73)	87 (24)	60 (81)	23 (15)	825 (55)
Adult endocrinologist	3 (1)	26 (5)	160 (45)	0 (0)	25 (17)	214 (14)
Generalist	12 (3)	25 (5)	60 (17)	8 (11)	56 (37)	161 (11)
Nurse practitioner/physician assistant	94 (24)	85 (16)	34 (10)	5 (7)	16 (11)	234 (16)
Other	6 (2)	9 (2)	16 (4)	1 (1)	30 (20)	62 (4)
Duration of diabetes, mean ± SD, mo	45.5 ± 19.5	68.9 ± 43.3	121.5 ± 61.4	42.6 ± 11.9	86.6 ± 34.8	75.9 ± 51.1

were 12 years of age or older. Ages ranged from 3 to 27 years, with a median of 15 years. Forty-eight percent of the subjects were non-Hispanic white, 20% black, 21% Hispanic, and 11% other (including Asian, Pacific Islander, American Indian, and mixed race/ethnicity, combined into 1 group because of small sample sizes) (Table 1). The duration of diabetes at the time of survey completion ranged from 23 to 288 months, with a median time since diagnosis of 51 months. Overall, 5% of participants reported having no insurance at the time of the survey and 11% reported gaps in insurance coverage during the preceding year, with larger proportions among older participants.

The proportions of participants who reported receiving each of the 5 ADA-recommended tests (among those who met the criteria for receiving them), according to age and diabetes type, are presented in Table 2. Overall, 95% of participants reported undergoing blood pressure checks at all or most visits. Fewer participants reported undergoing lipid level measurements (88%) and kidney function tests (83%) with the frequency and time intervals recommended by the ADA for their respective diabetes type and age group. Only 66% reported undergoing an eye examination as recommended, and 68% reported undergoing HbA1c testing with the recommended frequency. Rates for the incident and

prevalent cases included in the sample were calculated separately, and no substantive differences were found (data not shown).

Participants aged 18 years or older tended to have fewer tests of all kinds performed regardless of their diabetes type, but particularly with type 2 diabetes. Only 45% of participants aged 18 years or older with type 2 diabetes reported having their HbA1c levels measured with the recommended frequency, compared with 70% of participants 12 to 17 years of age ($P = .0009$). Significant differences between these 2 age groups also were found with respect to lipid level and blood pressure measurements and kidney

TABLE 2 Proportion of Respondents Who Reported Receipt of Measurement, According to Age Category and Diabetes Type

	No. Reported Receiving Test/No. Met Criteria for Test (%)					Total
	Type 1 Diabetes			Type 2 Diabetes		
	3–11 y ^a	12–17 y	≥ 18 y	12–17 y	≥ 18 y	
HbA1C level measured ^b	302/377 (80) ^c	379/519 (73) ^c	191/346 (55) ^c	46/66 (70) ^c	58/130 (45) ^c	976/1438 (68)
Lipid levels measured ^b	NA	416/433 (96) ^c	262/315 (83) ^c	58/58 (100) ^c	86/125 (69) ^c	822/931 (88)
Blood pressure measured ^b	360/380 (95)	508/526 (97)	339/353 (96)	69/72 (96) ^c	118/144 (82) ^c	1394/1475 (95)
Microalbuminuria measured ^b	27/31 (87)	178/196 (91)	218/261 (84)	57/64 (89) ^c	86/132 (65) ^c	566/684 (83)
Eye examination performed ^b	20/34 (59)	155/209 (74)	187/278 (67)	46/69 (67)	74/141 (52)	482/731 (66)

Results include only data for subjects who met the criteria for each test, and they exclude patients with missing test data and those who responded “do not know.” NA indicates not applicable.

^a The number of participants 10 to 11 years of age with a diabetes duration of ≥ 5 years was 28.

^b The χ^2 *P* value was <.01 for differences among age/type groups for this measurement.

^c Values were significantly different (*P* < .05) between the age groups within diabetes type.

function testing. Among participants with type 1 diabetes, significant differences between age groups were found for HbA1c testing (55% for age 18 years or older, compared with 73% for ages 12–17 years and 80% for age 11 years or younger; *P* < .0001) and for lipid level measurements (83% for age 18 years or older, compared with 96% for ages 12–17 years; *P* < .0001).

Three characteristics emerged as important correlates of quality of care (*P* ≤ .01) in the multivariate logistic regression model including all 1087 participants with complete data, namely, age group, family income, and type of diabetes care provider (Table 3). The odds ratios for participants aged 12 to 17 years and 18 years or older receiving all of the recommended tests were 0.60 (95% confidence interval: 0.43–0.83) and 0.40 (95% confidence interval: 0.25–0.62), respectively, compared with participants younger than 12 years of age. Compared with individuals from families with annual incomes of \$25 000 or less, individuals from families with annual incomes of \$75 000 had >65% increased odds of receiving all recommended tests. Individuals who received care from generalists and other diabetes care providers were less likely to receive all recommended tests, compared with pediatric endocrinologists or nurse practitioners/physician assistants. Family income was significantly associated with the

TABLE 3 Odds Ratios for Receiving All Recommended Tests, According to Demographic and Clinical Characteristics

	Odds Ratio (95% Confidence Interval)			
	All Patients (<i>N</i> = 1087)	3–11 y (<i>N</i> = 349)	12–17 y (<i>N</i> = 415)	≥ 18 y (<i>N</i> = 323)
Gender, <i>P</i>	—	—	—	.0387
Male	Reference	Reference	Reference	Reference
Female	1.12 (0.85–1.46)	0.86 (0.52–1.43)	1.00 (0.65–1.53)	1.74 (1.03–2.95)
Age group, <i>P</i>	.0001	—	—	—
<12 y	Reference	—	—	—
12–17 y	0.60 (0.43–0.83)	—	—	—
≥ 18 y	0.40 (0.25–0.62)	—	—	—
Race/ethnicity, <i>P</i>	—	—	.0281	—
White	Reference	Reference	Reference	Reference
Black	0.74 (0.49–1.13)	1.21 (0.45–3.26)	0.58 (0.30–1.12)	0.84 (0.38–1.88)
Hispanic	0.83 (0.55–1.27)	0.82 (0.31–2.15)	0.74 (0.39–1.43)	1.09 (0.50–2.37)
Other	0.65 (0.37–1.13)	0.74 (0.24–2.28)	0.24 (0.09–0.66)	2.20 (0.78–6.16)
Annual family income, <i>P</i>	.0116	.0200	—	—
Below \$25 000	Reference	Reference	Reference	Reference
\$25 000–\$49 000	0.83 (0.53–1.31)	0.78 (0.29–2.07)	0.68 (0.33–1.43)	1.22 (0.55–2.74)
\$50 000–\$74 000	1.41 (0.84–2.35)	2.61 (0.87–7.84)	1.01 (0.44–2.32)	1.65 (0.62–4.37)
Above \$75 000	1.66 (1.01–2.71)	2.08 (0.72–6.00)	1.24 (0.54–2.87)	2.84 (1.15–7.00)
Do not know/refused to answer	0.86 (0.51–1.45)	0.49 (0.11–2.16)	1.93 (0.63–5.92)	0.84 (0.40–1.81)
Family composition	—	—	—	—
2-parent household	Reference	Reference	Reference	Reference
1-parent household	1.06 (0.77–1.45)	0.85 (0.41–1.73)	1.06 (0.64–1.78)	1.29 (0.74–2.23)
Diabetes type	—	—	—	—
1	Reference	—	Reference	Reference
2	0.84 (0.53–1.35)	—	.81 (0.39–1.70)	.67 (0.33–1.37)
Diabetes care provider, <i>P</i>	.0040	—	—	—
Pediatric endocrinologist	Reference	Reference	Reference	Reference
Adult endocrinologist	0.79 (0.49–1.26)	—	1.06 (0.34–3.24)	0.59 (0.32–1.09)
Generalist	0.40 (0.24–0.68)	—	0.36 (0.13–0.99)	0.37 (0.17–0.81)
Nurse practitioner/physician assistant	1.01 (0.66–1.52)	—	1.23 (0.63–2.38)	0.42 (0.16–1.12)
Other	0.32 (0.12–0.85)	0.83 (0.41–1.73)	1.93 (0.17–21.7)	0.12 (0.02–0.66)
Insurance type	—	—	—	—
Private	Reference	Reference	Reference	Reference
Medicaid/Medicare	1.13 (0.77–1.65)	—	—	1.02 (0.51–2.02)
Other	1.20 (0.59–2.44)	1.54 (0.71–3.33)	1.08 (0.58–2.01)	1.29 (0.53–3.10)
None	0.84 (0.33–2.15)	—	—	0.49 (0.13–1.80)
Continuously insured in past 12 mo	—	—	—	—
Yes	Reference	Reference	Reference	Reference
No	0.71 (0.39–1.30)	0.71 (0.21–2.39)	0.62 (0.23–1.67)	0.97 (0.39–2.39)

Analyses included only cases with no missing test or covariate data. Models included all variables shown plus the SEARCH for Diabetes in Youth study site.

quality-of-care summary variable ($P = .02$) for children between 3 and 11 years of age, race/ethnicity was significantly associated with quality of care for youths between 12 and 17 years of age ($P = .03$), and gender and diabetes care provider specialty were associated with quality of care for participants aged 18 years or older ($P = .04$). Type of health insurance and 1- versus 2-parent household did not account for significant differences in receipt of care.

DISCUSSION

Our study confirms previous findings that children and youths are vulnerable to receiving suboptimal ambulatory care.^{8,13,14} Children and youths with diabetes may face a greater risk of complications than do those who develop diabetes as adults, as a result of the earlier age of onset leading to longer duration of disease.^{1,2,15} Although the processes of care studied may not result directly in better outcomes for young people with diabetes, they are important for early identification and treatment of diabetes-related complications. The finding of suboptimal HbA1c testing is particularly troublesome because poor glycemic control is associated with complications.¹ Relatively low rates of eye examinations among some participants also are concerning. Other studies suggest that cost barriers and possibly the inconvenience of visiting an eye care specialist may contribute to suboptimal rates of eye examinations.^{16,17}

The results of this study indicate the vulnerability of older adolescents and young adults to receiving poorer quality of care. The transition to adulthood for young people with diabetes requires more responsibility for self-care and medical care. At the same time, there may be more perceived social pressure and desire to disregard the self-management required for optimal management of diabetes.¹⁸ Simi-

larly, the transition from pediatric to adult health care providers can result in the breakdown of established, effective, doctor-patient relationships, changes in the location of care, and possibly changes in health care benefits.^{3,19,20} Access problems, including being uninsured and having gaps in health insurance coverage, were more common among this group. On the basis of this cross-sectional analysis, we cannot say with certainty that quality of care for diabetes decreases as youths mature to young adulthood, although results suggest this. Quality of care may improve in later years; however, lapses in quality of care at any time during the course of diabetes may be detrimental to long-term outcomes.

Our findings highlight the significant association of income with receiving recommended tests, an association that remained after we controlled for other variables. Out-of-pocket medical care costs affect the utilization of preventive services for diabetes in adult populations and pose greater financial barriers to care for economically disadvantaged patients.¹⁶ Lower rates of eye examinations in particular have been found among low-income adult populations,²¹ and an eye examination was the most-often missed examination/test in our study. The mechanisms through which income, and socioeconomic position in general, can affect diabetes care are complex²² and potentially have an impact on many aspects of medical care, self-management, and ultimately outcomes of care.

There are limitations of this study that should be noted. First, the study relied on self-reported receipt of recommended diabetes tests and measurements. There is some evidence of good concordance between medical record and survey data regarding ambulatory care services.²³ In addition, all questions about receipt of services allowed respondents to reply “do not know/not

sure.” Very few respondents chose this response option for HbA1c testing, blood pressure measurement, and eye examinations (proportions responding “do not know” or “not sure” ranged from 2.0% to 4%), although there was somewhat less certainty about lipid level and kidney function testing (18% and 13%, respectively). Evidence also suggests that self-reports of eye examinations and HbA1c testing actually may overestimate the services performed.²⁴ Therefore, the true rates of receipt of these 2 tests may be lower than the results we found.

Although process measures of care are important indicators of quality, receipt of these services depends on many factors. Our study data do not enable us to determine the degree to which failure to receive recommended care was attributable to patients, providers, health care systems, or other barriers to care. Also, the dichotomously coded, quality-of-care summary indicator reflects whether participants reported receiving all of the tests recommended by the ADA on the basis of their age, diabetes type, and diabetes duration. The indicator does not take into account the number of recommended tests that were missed. Because 5 tests are recommended for older participants and those with type 2 diabetes, compared with only 2 tests for most younger participants with type 1 diabetes, older participants had a greater chance of missing a test and failing to meet the criteria for having optimal diabetes-related care. Nevertheless, assessments of individual quality measures showed poorer results for youths aged 18 years or older than for younger participants, with few exceptions.

Strengths of this study include recruitment from a population-based sample, racial/ethnic and socioeconomic diversity, ages ranging from 3 to 27 years, participants with type 1 and type 2 diabetes, and the use of well-

established indicators of diabetes-related health care quality. Study results also are based on a broad spectrum of diabetes care delivery models throughout the United States, with diversity in provider specialties and delivery settings.

CONCLUSIONS

The results of this study can provide direction for intervention strategies to improve the care and outcomes of children and youths with diabetes. Our findings add evidence supporting the need to assist youths with chronic health conditions as they transition to adulthood and adult health care. Our finding that income is associated with reported receipt of recommended diabetes-related services highlights the potential impact of cost barriers on other aspects of care, which warrants further investigation among children and youths with diabetes.

APPENDIX: QUALITY-OF-CARE SURVEY ITEMS

1. A test for hemoglobin A1c (“A one C”) measures the average level of blood sugar over the past 3 months. About how many times in the past 12 months has a doctor or other health care provider checked your hemoglobin A1c (none, once, twice, 3 or more times, or do not know/not sure)?
2. During the past 12 months, how often has your blood pressure been checked during visits to your doctor’s office (every visit, most visits, at least once, never, or do not know/not sure)?
3. When was the last time you had your eyes examined by an eye specialist in which your pupils were dilated (drops in your eyes that make eyes temporarily sensitive to bright light) or had a diabetes eye examination (in the past year, >1 year but <2 years, 2–5 years, >5 years, never, or do not know/not sure)?
4. When was the last time your doctor took a sample of your blood to test for cholesterol or the amount of fat in the blood (in the past year, >1 year but <2 years, 2–5 years, >5 years, never, or do not know/not sure)?
5. When was the last time you had a urine test at the doctor’s office to check kidney function (in the past year, >1 year but <2 years, 2–5 years, >5 years, never, or do not know/not sure)?

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