Evaluation of Quality of Diabetes Care in a Multiethnic, Low-Income Population

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Abstract

- *Objective:* To evaluate glycemic and risk factor control for a cohort of patients with diabetes over a 1-year period and to determine the proportion of patients meeting clinical practice guideline treatment goals.
- *Design:* Retrospective, cross-sectional cohort study.
- *Setting and participants:* Primarily low-income persons with type 2 diabetes served by a rural community health clinic in North Carolina during 2006.
- *Measures:* Attainment of treatment goals related to glycated hemoglobin A_{1c} (HbA1c), blood pressure, and lipid control. Descriptive statistics were applied to demographic variables. Mean differences in outcomes were assessed and multivariate logistic regression models were applied.
- *Results:* There were several differences in diabetes care indicators by ethnicity. Mean HbA1c levels and rates of HbA1c greater than 8% were higher among Hispanics compared with African Americans and non-Hispanic whites. African Americans were more likely than Hispanics or non-Hispanic whites to achieve a triglyceride level less than 150 mg/dL. Hispanics had a lower mean systolic blood pressure and were more likely to achieve the blood pressure target less than 130/80 mm Hg compared with African Americans or non-Hispanic whites. There were no differences by ethnicity in the simultaneous control of HbA1c, blood pressure, and low-density lipoprotein cholesterol.
- *Conclusion:* In this chart review, there was a significant disparity in HbA1c and total cholesterol levels achieved for Hispanics as compared with non-Hispanic whites and African Americans. In comparison with national data, however, Greene County Health Care is doing a comparable job meeting diabetes goals for HbA1c, blood pressure, and lipid levels and in some instances is achieving better outcomes despite predominantly low-income clients. Further evaluation is warranted to determine strategies that can help Hispanics meet diabetes goals.

The burden of diabetes disproportionally falls on minority populations in the United States [1]. Several complications of diabetes, including end-stage renal disease, amputation, retinopathy, and neuropathy, are also substantially more prevalent among some ethnic minority groups (ie, African Americans, Hispanics, Native Americans) [2–7]. Many complications can be prevented or delayed by intensive management of risk factors for diabetes complications, such as high blood pressure and dyslipidemia [8,9].

The American Diabetes Association (ADA) annually publishes guidelines delineating standards of diabetes care and treatment goals [10]. In addition, in 1997 the national Diabetes Quality Improvement Project developed a set of standard diabetes care measurements to be used to assess the level of care provided within a system of care to patients with diabetes [11]. Despite these efforts, care of adults with diabetes in the United States remains suboptimal [1]. Further, minority and underserved patients are less likely to receive recommended processes of care (eg, HbA1c and lipid tests) and more likely to have poorer glycemic control and management of risk factors for complications [12–21].

The health care challenges faced in poor rural communities include fewer providers as well as significant numbers of individuals without health insurance or who are underinsured [22,23]. Medically underserved populations are at greater risk of diabetes and its complications [24]. The more than 5000 federally funded community health center sites in the United States play a vital role in caring for the medically indigent, uninsured, and high-risk populations. Patients receive care regardless of insurance status or ability to pay. Over half of the patients served are from minority groups (23% African American, 36.1% Hispanic, 36.3% white) [25]. In this study, we used data from a rural community health

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DIABETES CARE

Table 1. Patient Characteristics, Type of Insurance, and Ethnicity

Variable	Non-Hispanic White	African American	Hispanic	Total
Total number	195	375	209	779
Mean age, yr (SD)	60.1 (16.4)	58.5 (15.5)	44.5 (12.4)	55.3 (16.4)
Sex, % female	56.4	68.5	57.8	57.3
Insurance, %				
Uninsured	17.4	17.1	86.6	35.8
Private insurance	27.2	27.2	8.1	19.1
Medicare only	33.9	33.9	0.5	18.1
Medicaid only	9.2	9.2	3.4	10.8
Medicare and Medicaid	12.3	12.3	1.4	16.2

SD = standard deviation.

clinic in North Carolina to assess care of patients with diabetes among a predominately low-income, rural population. We also examine potential racial and ethnic differences in diabetes treatment and care.

Methods

Setting
Greene County is a rural community located in the eastern coastal region of North Carolina. A county health assessment identified diabetes as the third most pressing health concern among residents, behind obesity and heart disease [26]. Greene County Health Care, Inc., comprising 4 clinics, is a federally funded community health center that serves a population of approximately 28,000 patients, with 21,791 seen in 2006. Family practice physicians, an internist, a pediatrician, and midlevel practitioners serve as the health care providers among the 4 clinic practices. Among all patients served by community health centers in North Carolina in 2006, 37.7% were African American, 31.5% were Hispanic, 27.5% were non-Hispanic white, and 2.6% were Native American. Many Hispanic patients are members of migrant farm worker families. Almost three quarters of community health center patients in North Carolina in 2006 reported family incomes below 200% of the federal poverty level [27].

Greene County Health Care clinics use an electronic health record (EHR) system, which was implemented in 2000.

Measurement
We sought to determine which patients in the cohort achieved treatment goals at 1 year as delineated in the ADA Standards of Care:

HbA1c	< 7%
Blood pressure	< 130/80 mm Hg
Lipids	
Total cholesterol	< 200 mg/dL
Triglycerides	< 200 mg/dL
Low-density lipoprotein (LDL)	< 100 mg/dL
High-density lipoprotein (HDL)	> 40 mg/dL

Data Collection
Patients with an ICD-9 code for diabetes (250.x) were identified from the EHR for the 2006 calendar year. We excluded persons with gestational diabetes–related ICD-9 codes. ICD-9 codes do not distinguish between type 1 and type 2 diabetes. De-identified patient data were extracted from the EHR. For this chart review, extracted data were limited to insurance type, race/ethnicity, sex, month and year of birth, number of visits, blood pressure values, and laboratory data (HbA1c and lipid levels). Patients are asked to self-identify as 1 race/ethnic group; the data system does not allow for the recording of multiple groups. Family income level was not extracted, and we did not obtain any data on persons without diabetes. We used the last recorded values in calendar year 2006 to assess achievement of ADA goals.

Statistical Analysis
Descriptive statistics for each process of diabetes care indicator were calculated. Differences in process of care variables by ethnicity were compared using 1-way analysis of variance and F statistics for continuous outcomes (eg, systolic blood pressure) or cross-tabulations with chi-square statistics for dichotomous outcomes (eg, HbA1c < 7%). Logistic regression was used to estimate adjusted odds ratios and 95% confidence intervals for achieving treatment goals by ethnicity, comparing Hispanics and African Americans with non-Hispanic whites. These models adjusted for age, gender, and insurance status. A 2-tailed P value of less than 0.05 was considered significant in all analyses. All analyses were performed using SAS version 9.2 (SAS Institute, Cary, NC).

Results
We identified 786 unique individuals with diabetes seen during calendar year 2006; 7 individuals were excluded from the analysis because their ethnicity was unknown. The ethnic composition of the final sample of 779 patients was 48.1% African American, 26.8% Hispanic, and 25.1% white (**Table 1**). A majority of patients were female. Hispanic patients tended to be younger compared with white or African-American patients. There were significant differences in insurance status (χ^2 = 363.17; df = 8; P < 0.001). Whereas the vast majority of Hispanics were uninsured, less than one fifth of whites and African Americans did not have insurance. Private insurance was most common among non-Hispanic whites

Table 2. Descriptive Statistics for Indicators of Diabetes Management*

Variable	No. of Measurements (SD)	Value Mean (SD)	Median (Range)	Patients Achieving Goal, %
HbA1c	1.1 (1.1)	7.53% (1.81)	7% (4.3–14)	50.0
Systolic BP	4.6 (3.3)	129.5 mm Hg (17.5)	128 mm Hg (80–224)	49.3
Diastolic BP	4.6 (3.3)	77.6 mm Hg (10.9)	77 mm Hg (40–124)	57.3
TC	0.6 (0.7)	186.0 mg/dL (43.0)	180 mg/dL (95–347)	66.5
LDL cholesterol	0.6 (0.7)	103.6 mg/dL (34.8)	99 mg/dL (2–262)	52.6
HDL cholesterol	0.6 (0.7)	51.2 mg/dL (13.6)	49 mg/dL (23–118)	76.9
Triglycerides	0.6 (0.7)	142.7 mg/dL (74.5)	122 mg/dL (31–391)	63.7

BP = blood pressure; HDL = high-density lipoprotein; LDL = low-density lipoprotein; SD = standard deviation; TC = total cholesterol.

*Based on a data obtained from 4028 health care encounters from 779 unique individuals.

Table 3. Diabetes Quality Indicators by Ethnicity*

Indicator	Non-Hispanic White	African American	Hispanic
Total sample	195	375	209
Health visits, n	5.4 (3.3)	5.7 (3.6)	4.0 (2.9)[†‡]
HbA1c, %	7.3 (1.7)	7.4 (1.7)	8.1 (2.0)[†‡]
Systolic BP, mm Hg	130.1 (15.2)	133.2 (18.68)	122.2 (15.0)[†‡]
Diastolic BP, mm Hg	75.4 (10.4)	79.1 (11.7)	77.2 (9.2)[†]
TC, mg/dL	189.5 (47.1)	180.5 (40.8)	193.8 (42.9)[‡]
LDL cholesterol, mg/dL	103.1 (36.9)	101.9 (34.4)	107.7 (33.9)
HDL cholesterol, mg/dL	49.8 (11.8)	54.98 (14.8)[†]	44.9 (9.9)[†‡]
Triglycerides, mg/dL	163.6 (74.6)	117.8 (58.7)[†]	177.7 (85.7)[‡]

BP = blood pressure; HDL = high-density lipoprotein; LDL = low-density lipoprotein; TC = total cholesterol.

*Based on the mean of all observations across 2006 for each individual in the registry.

[†]Significantly different from non-Hispanic whites.

[‡]Significantly different from African Americans ($P < 0.05$).

and African Americans while least common among Hispanics (Table 1). Medicare only was the most common form of insurance among whites, whereas the combination of both Medicare and Medicaid was most common among African Americans.

Patients with diabetes had in aggregate 4028 health care encounters in 2006, or an average of 5.1 visits per person per year with a standard deviation of 3.42. The mean number of process measures obtained and median HbA1c, blood pressure, and lipid values for all the observations are shown in **Table 2**. The proportion of individuals whose last observed value for each measure was at goal is also included in Table 2.

Hispanic patients had significantly fewer health visits than whites or African Americans and had significantly higher HbA1c than non-Hispanic white individuals (**Table 3**). There were significant differences in systolic blood pressure,

diastolic blood pressure, total cholesterol, HDL cholesterol, and triglycerides by race/ethnicity. Average HDL cholesterol and systolic blood pressure were lower for Hispanics than non-Hispanic whites and African Americans, but Hispanics had higher triglyceride levels. There were few significant differences between non-Hispanic whites and African Americans in this sample; however, non-Hispanic whites had less adverse HDL and triglyceride values (Table 3).

The proportion of patients meeting ADA goals by race/ethnicity at the last encounter is presented in **Table 4**. There was a significant difference in glycemic control by ethnicity (HbA1c < 7%, $P = 0.04$; HbA1c > 8%, $P < 0.001$; both univariate). After adjusting for age, gender, and insurance status, the odds of having high HbA1c was greater for Hispanics than non-Hispanic whites. Hispanics were more likely to meet the systolic blood pressure goal than non-Hispanic whites. African Americans were not significantly different

Table 4. Glycemic and Risk Factor Control at Last Clinical Encounter

Indicator	Non-Hispanic White	African American	Hispanic	Odds Ratios* (95% CI)	
				African American	Hispanic
HbA1c < 7%	54.0%	52.6%	40.3%	0.94 (0.60–1.47)	0.64 (0.34–1.21)
HbA1c > 8%	23.9%	24.1%	43.4%	0.99 (0.58–1.68)	2.03 (1.00–4.12)[†]
BP < 130/80 mm Hg	38.7%	34.9%	41.4%	0.81 (0.56–1.16)	1.03 (0.62–1.71)
Systolic BP < 130 mm Hg	45.9%	42.7%	65.0%	0.81 (0.57–1.16)	1.89 (1.13–3.14)[†]
Diastolic BP < 80 mm Hg	64.4%	56.5%	52.7%	0.70 (0.48–1.02)	1.01 (0.60–1.69)
TC < 200 mg/dL	58.6%	72.7%	61.1%	1.97 (1.15–3.38)[‡]	1.41 (0.65–3.08)
LDL cholesterol < 100 mg/dL	48.1%	57.1%	47.7%	1.54 (0.90–2.62)	1.41 (0.64–3.12)
HDL cholesterol > 40 mg/dL	76.7%	82.3%	65.3%	1.14 (0.60–2.19)	0.63 (0.26–1.51)
Triglycerides < 150 mg/dL	46.9%	77.3%	50.0%	4.07 (2.32–7.16)[§]	1.22 (0.55–2.74)
Controlled HbA1c, BP, and LDL cholesterol	9.2%	10.9%	16.9%	1.09 (0.41–2.91)	2.30 (0.57–9.24)

BP = blood pressure; CI = confidence interval; HDL = high-density lipoprotein; LDL = low-density lipoprotein; TC = total cholesterol.

*Odds ratios from multivariate logistic regression models where non-Hispanic white is the reference group and the models control for the effects of age, gender, and insurance status.

[†]$P < 0.05$.

[‡]$P < 0.01$.

[§]$P < 0.001$ (2-tailed).

from non-Hispanic whites in terms of meeting ADA goals except for being more likely to have total cholesterol less than 200 mg/dL and triglycerides less than 150 mg/dL. Meeting the combined goal of HbA1c less than 7%, blood pressure less than 130/80 mm Hg, and LDL cholesterol less than 100 mg/dL was infrequent, with a total of 37 individuals (11.8%) controlled at the last clinic visit; of patients meeting ADA goals, 9.2% were non-Hispanic white, 10.9% were African American, and 16.9% were Hispanic (Table 4).

Discussion

We assessed rates of HbA1c, blood pressure, and lipid control among patients with diabetes seen at a rural community health center in North Carolina in 2006. Approximately half of the patients in our sample achieved HbA1c, blood pressure, and lipid goals. On average, rates of control were comparable or higher than those reported in the National Health and Nutrition Examination Survey (NHANES) 1999–2002 [17,28]. For the combined endpoint of HbA1c less than 7%, blood pressure less than 130/80 mm Hg, and LDL cholesterol less than 100 mg/dL, our chart review showed an overall rate of control of 11.2%. According to 2001–2002 NHANES data, only 5.3% of men and 12.7% of women with diabetes were simultaneously at goal for HbA1c, blood pressure, and total cholesterol [28].

With regard to monitoring for patients with diabetes, the ADA recommends an HbA1c test quarterly in patients who

are not at goal or for whom therapy has changed, blood pressure measurement at routine visits, and lipid measurement annually [10]. Some factors specific to Greene County Health may in part explain the results we observed. Greene County utilizes an EHR with many capabilities for tracking patients (facilitating a diabetes registry), prompts at visits, and patient reminders that can be sent for follow-up appointments. They have also utilized the "chronic care model" and the "rapid cycle improvement model" to attempt to organize health care as part of a collaborative effort [29,30].

We found that diabetes care processes and outcomes differed by race/ethnicity. In our study, Hispanics had poorer glycemic control, a finding consistent with reports of Mexican Americans having higher HbA1c than African Americans or whites [3,17]. NHANES data from 2003–2004 showed 34% of Mexican Americans reaching the HbA1c goal of less than 7% as compared with 43.5% of African Americans and 63.5% of non-Hispanic whites [18]. In our study, the lower proportion of Hispanics with an HbA1c less than 7% was not statistically significant after accounting for differences in age, gender, and insurance; however, Hispanics were more likely to have an HbA1c greater than 8% in adjusted analyses. HDL cholesterol and triglyceride levels were more likely to be controlled in African Americans as compared with non-Hispanic whites. We found no differences between African American and non-Hispanic whites in respective rates of achieving HbA1c, blood pressure, and LDL control.

There are several plausible reasons for the disparity found in HbA1c among Hispanics in our review. Hispanics were observed to have fewer health visits than both non-Hispanic whites and African Americans. This may reflect the fact that most (approximately 80%) of the Hispanic patients are migrant farm workers. Many were uninsured and, while still eligible to be seen at this clinic, may have fewer resources at their disposal to sustain diet or self-care activities. It is possible that the differences in age between the Hispanics and the non-Hispanic whites and African Americans may contribute to our results given evidence indicating that younger adults have poorer HbA1c control [31]; however, ethnic differences in elevated HbA1c values persisted even after controlling for age. A more likely explanation for higher rates of elevated HbA1c among Hispanics is behavioral: previous research suggests that Hispanics are less likely to have their HbA1c checked annually [32], potentially contributing to poorer control. This explanation is consistent with our data indicating that Hispanics had fewer health care encounters than non-Hispanic whites and African Americans. Future studies will need to examine the role of annual or semiannual monitoring of HbA1c in overall levels of control.

A limitation of our analysis is that a relatively small sample was evaluated for a single year. This limits the power for comparisons between clinics, particularly when performing adjustments for potential confounders. Also, while differences were seen between ethnic groups in the number of health visits, we do not know if this reflects fewer appointments made for these patients or more missed appointments. We were also not able to control for the fact that the majority of Hispanics from this chart review are migrant farm workers.

Community health centers are playing an active role in addressing the challenge to reduce health care disparities in North Carolina [33]. Greene County Health is a participant in the federally funded Health Disparities Collaborative [29]. In addition, reducing and eliminating disparities in diabetes care has been a focus for state-based Diabetes Prevention and Control Programs (DPCPs), which receive funding from the Centers for Disease Control and Prevention. The primary goal of the DPCPs is to improve access to affordable, high-quality diabetes care and services, with priority on reaching high-risk and disproportionately affected populations. The addition of more community health centers may help address diabetes-related disparities.

Although the processes of care and control of risk factors at this community health center compared favorably with national data, there is also ample room for improvement. Strategies that can help Hispanic migrant farm workers to meet diabetes goals are needed. Hispanics are the fastest growing minority group in the United States, with par-

ticularly rapid growth of Hispanic settlements in the rural southeast. Community health centers situated in these new settlement areas likely need additional resources to better meet the health care needs of Hispanics and to provide culturally appropriate strategies for effective diabetes self-management. Additional efforts to address the challenge of diabetes control both in the populations served by this community health center as well as in the population at large should be a future focus.

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