

SPECIAL ARTICLE

Improving the Management of Chronic Disease at Community Health Centers

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ABSTRACT

BACKGROUND

The Health Disparities Collaboratives of the Health Resources and Services Administration (HRSA) were designed to improve care in community health centers, where many patients from ethnic and racial minority groups and uninsured patients receive treatment.

METHODS

We performed a controlled preintervention and postintervention study of community health centers participating in quality-improvement collaboratives (the Health Disparities Collaboratives sponsored by the HRSA) for the care of patients with diabetes, asthma, or hypertension. We enrolled 9658 patients at 44 intervention centers that had participated in the collaboratives and 20 centers that had not participated (external control centers). Each intervention center also served as an internal control for another condition. Quality measures were abstracted from medical records at each health center. We created overall quality scores by standardizing and averaging the scores from all of the applicable measures. Changes in quality were evaluated with the use of hierarchical regression models that controlled for patient characteristics.

RESULTS

Overall, the intervention centers had considerably greater improvement than the external and internal control centers in the composite measures of quality for the care of patients with asthma and diabetes, but not for those with hypertension. As compared with the external control centers, the intervention centers had significant improvements in the measures of prevention and screening, including a 21% increase in foot examinations for patients with diabetes, and in disease treatment and monitoring, including a 14% increase in the use of antiinflammatory medication for asthma and a 16% increase in the assessment of glycated hemoglobin. There was no improvement, however, in any of the intermediate outcomes assessed (urgent care or hospitalization for asthma, control of glycated hemoglobin levels for diabetes, and control of blood pressure for hypertension).

CONCLUSIONS

The Health Disparities Collaboratives significantly improved the processes of care for two of the three conditions studied. There was no improvement in the clinical outcomes studied.

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SERIOUS PROBLEMS WITH THE QUALITY OF care and disparities in quality according to the race or ethnic group and socioeconomic status of patients have been documented in the U.S. health care system.¹⁻⁵ These overlapping issues are of particular concern for community health centers. These centers provide care for more than 15 million Americans, many of whom are underinsured or uninsured or are members of immigrant or minority groups that, in general, have received care of lower quality than that received by nonimmigrant white patients.^{2,5,6} Furthermore, policymakers are increasingly relying on community health centers to assume the burden of care for the growing numbers of uninsured patients.⁷

Strategies to reduce disparities generally take one of two forms. In some cases, targeted programs focus on care for a particular class of patients. For instance, a quality-improvement program might be developed for a specific population, such as blacks with hypertension. A more common approach, however, is the development and implementation of programs to improve quality more broadly, with an expectation that across-the-board improvements in quality will narrow gaps in care.^{8,9} Moreover, these broader programs may target settings that care for large proportions of disadvantaged populations. One of the most important national initiatives of this type is the Health Disparities Collaboratives sponsored by the Health Resources and Services Administration (HRSA).

These collaboratives bring community health centers together to learn and disseminate quality-improvement techniques developed by the Institute for Healthcare Improvement.¹⁰⁻¹² The rapid-cycle improvement method first requires the establishment of aims based on known deficiencies in quality. Then, each community health center implements and tests small-scale interventions at one or more practice sites. On the basis of these tests, new practices and procedures are adopted and refined. Successful interventions are then disseminated throughout the entire community health center. Since 1998, about two thirds of community health centers (645 centers to date) have voluntarily participated in collaboratives focusing on improving care for chronic medical conditions. To date, however, there has been no controlled evaluation of the effect of the Health Disparities Collaboratives on the quality of care. We re-

port the results of a controlled, national evaluation of these collaboratives for the care of patients with three prevalent chronic medical conditions.

METHODS

COMMUNITY HEALTH CENTERS

We enrolled community health centers participating in collaboratives to improve the care of patients with diabetes, asthma, or cardiovascular disease. For cardiovascular disease, we focused our assessment on the improvement of care for patients with hypertension. We compared each intervention center with a participating center in another collaborative and a center that had never participated in a collaborative, using a difference-in-differences design. The earliest collaborative started on January 1, 2000, and the latest collaborative started on August 1, 2001. Our study is based on data from care delivered during the period from January 1, 1999, to August 1, 2003.

Of the 238 eligible community health centers identified by HRSA as participating in an eligible collaborative, 138 (58%) agreed to participate in our independent evaluation. Of these centers, 44 intervention centers were selected on the basis of region, location (rural, urban, or mixed), the number of practice sites included in the center, and caseload. Each of these centers was also asked to serve as an internal control for one of the other conditions under study, and 40 were able to do so. Potential external control centers (that had never participated in a collaborative) were then matched with intervention centers according to the same variables that were used to select the intervention centers, yielding 34 potential external control centers of which 20 (59%) agreed to participate in the study. Three external control centers provided data for only one or two of the three conditions. For each center, we included one or two practice sites in the evaluation: the lead collaborative site, which was usually the largest site and included the team leader for the intervention, and one additional practice site that was randomly selected. Although most of the health centers in the collaboratives initially focused their efforts on a smaller population (e.g., at a specific practice site), successful interventions were designed to be spread to the entire community health center population.

QUALITY-IMPROVEMENT INTERVENTION

The Health Disparities Collaboratives have been described in detail previously.¹³ Briefly, each collaborative generally includes 20 or more community health centers and consists of a prework period, a kickoff meeting, and subsequent 2-day learning sessions. During the learning sessions, improvement teams from each organization receive instruction on quality-improvement techniques, the use of a software registry program, and the Chronic Care Model, which identifies the essential elements of health care delivery systems that are necessary to provide high-quality care to patients with chronic diseases and thus helps centers identify target areas for interventions.¹⁴ Teams also have opportunities to share knowledge gained from their own experiences with rapid-cycle improvement techniques. Between the sessions, during “action periods,” team members implement improvements based on the ideas discussed in the sessions. Each community health center also has access to a collaborative users group on the Internet, participates in monthly conference calls with the collaborative leaders, and submits monthly reports on its improvement interventions. The HRSA also developed a regional and state infrastructure that provides technical assistance and information systems support to community health centers participating in the collaboratives.

STUDY POPULATION

We selected sequential, random samples of patients with each condition during the 1-year period before the beginning of the collaborative and the 1-year period beginning 1 year after the completion of the collaborative. These samples were selected with the use of electronic lists generated by each center on the basis of automated billing data and diagnostic codes. Each patient had to have been seen at the center at least once during the relevant measurement year and at least once before the measurement year. From each of these lists, we randomly selected 40 patients after excluding all patients with end-stage renal disease, cancer, or human immunodeficiency virus infection. For the group of patients with diabetes and hypertension, we excluded patients who were younger than 18 years of age or pregnant. For the group of patients with asthma, we excluded patients who were younger than 2 years of age. For

the results presented here, we also excluded patients younger than 6 years of age because of the uncertainty of the asthma diagnosis in this population. Including the additional patients between 2 and 6 years of age did not substantively alter our results.

REVIEW OF MEDICAL RECORDS

One to four abstractors at each health center abstracted data from the medical records for the 1-year reporting periods. These data included sociodemographic information, coexisting medical or psychiatric illnesses, and disease-specific quality indicators for preventive care and screening, disease monitoring and treatment, and intermediate outcomes of care. The quality-of-care measures (Table 1) were selected to coincide with the required and optional quality-of-care measures identified by the collaborative faculty as areas for improvement. These measures were supplemented with existing validated measures. Because relatively few patients qualified for advice about smoking cessation, we created a composite measure that included both assessment of smoking status and advice about cessation.

STATISTICAL ANALYSIS

We compared the characteristics of the study centers with those of community health centers nationally, the characteristics of the intervention centers with those of the control centers, and, for each condition, the characteristics of the patient populations at the intervention centers with those of the patient populations at the control centers. We created an overall quality score and composite scores for prevention and screening, disease monitoring and treatment, and outcomes for each condition and for all conditions by averaging the scores of all of the indicators applicable to the patient. Because the number of applicable measures varied among patients and the proportion met varied among measures, the component scores were standardized to a mean of 0 and a variance of 1 before averaging. After averaging, we scaled the scores to have the same mean and variance as the overall proportion of measures met in the sample. Mean changes from baseline to follow-up within each of the three groups (intervention centers, internal control centers, and external control centers) and the relative change over time between the groups were assessed for each clinical mea-

Measure	Diabetes†	Hypertension‡	Asthma§
Preventive care and screening			
Assessment of smoking status and cessation advice to smokers	All patients	All patients	All patients
Influenza vaccination	All patients		All patients
Assessment of nephropathy	All patients	—	—
Annual dilated-eye examination	All patients	—	—
Annual dental examination	All patients	—	—
Annual foot examination	All patients without bilateral amputation	—	—
Disease monitoring and treatment			
≥2 Assessments of glycated hemoglobin per year	All patients	Patients who also have diabetes	—
Use of aspirin (daily)	Patients ≥40 yr of age	Patients who also have CAD	—
≥1 Assessment of lipid profile per year	All patients	All patients	—
Use of ACE inhibitor or angiotensin-receptor blocker	Patients with proteinuria and no contraindications to ACE inhibitors or angiotensin-receptor blockers	Patients who also have diabetes or congestive heart failure and no contraindications	—
Use of beta-blocker	—	Patients with CAD and no contraindications	—
≥1 Measurement of creatinine per year	—	All patients	—
≥2 Measurements of blood pressure per year	—	All patients	—
Assessment of asthma severity at 1 of 3 most recent visits during year	—	—	All patients
Use of antiinflammatory medication	—	—	All patients with persistent asthma
≥1 Assessment of exposure to smoke or other environmental triggers per year	—	—	All patients
Use of asthma management plan	—	—	All patients
Outcomes			
Most recent blood pressure ≤140/90 mm Hg, or ≤130/80 mm Hg for patients with diabetes or renal failure	All patients	All patients	—
Most recent glycated hemoglobin level ≤9%	All patients	All patients	—
Most recent LDL cholesterol level ≤100 mg/dl	Patients with ≥1 LDL measurement/yr	Patients with CAD or diabetes who had ≥1 LDL measurement/yr	—
≤2 Urgent care visits per yr and 0 hospital or emergency department visits per year for asthma	—	—	All patients

* To convert the value for LDL cholesterol to millimoles per liter, multiply by 0.02586. CAD denotes coronary artery disease, and ACE angiotensin-converting enzyme.

† The measures for smoking cessation, aspirin use, and use of ACE inhibitors and angiotensin-receptor blockers match the key and supplemental measures of the Bureau of Primary Health Care (BPHC) and HRSA Disparities Collaboratives.¹⁴ The nephropathy assessment, annual eye and foot examinations, glycated hemoglobin level of 9% or less, and low-density lipoprotein (LDL) cholesterol levels match the accountability measures of the Diabetes Quality Improvement Project.¹⁵ The influenza vaccination and glycated hemoglobin assessment measures match the clinical guidelines of the American Diabetes Association.¹⁶

‡ The measures for smoking cessation and creatinine match the key and supplemental measures of the BPHC and HRSA Disparities Collaboratives.¹⁴ The measures for use of beta-blockers, ACE inhibitors, and angiotensin-receptor blockers match the clinical guidelines of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VII) and those of the American Heart Association and the American College of Cardiology.¹⁷⁻¹⁹ The blood-pressure control determination matches the JNC VII guidelines and the standards of the Health Plan Employer Data and Information Set.^{17,20}

§ The measures for smoking cessation and the asthma management plan match the key and supplemental measures of the BPHC and HRSA Disparities Collaboratives.¹⁴ The measures for influenza vaccination, severity assessment, and use of antiinflammatory medication match the key clinical activities guidelines of the National Asthma Education and Prevention Program (NAEPP).²¹ The measures of urgent care and emergency department visits and hospitalizations match the NAEPP updates and the Healthy People 2010 asthma guidelines.^{21,22}

sure with the use of hierarchical linear and logistic-regression models that controlled for age, sex, race or ethnic group, insurance status, and an adapted version of the Charlson comorbidity index. We also performed a sensitivity analysis, including a term to test whether the intervention had a stronger effect in the lead practice site at the community health center than in the second selected site.

Finally, because community health centers might focus their improvement efforts on a particular condition, thereby diverting attention away from another condition (negative spillover effect), or because they might transfer the continuous quality-improvement techniques they learned as part of the collaborative to another condition (positive spillover effect), we also compared measures of improvement separately in the internal and external control centers. Greater improvement in the internal control centers than in the external control centers would be evidence of a positive spillover effect and vice versa.

RESULTS

STUDY CENTERS

The study centers were representative of community health centers nationally. Approximately half of the study centers were located in urban areas, and the centers were well distributed throughout the country. The average study center had approximately seven distinct sites of care (Table 2).

The community health centers that participated in the collaboratives implemented a variety of quality-improvement activities. On the basis of reports by 40 of the 44 intervention centers, the mean number of activities per center was 44 (range, 8 to 84) (Table 3).

CHARACTERISTICS OF THE PATIENTS

We studied 9658 patients with one of the three target conditions (3392 with asthma, 2904 with diabetes, and 3362 with hypertension) (Table 4). The average number of patients per center in the preintervention and postintervention periods was 41 (range, 16 to 84; median, 40). For illustrative purposes, we describe the patients with diabetes, but patients in the three groups were all similar, with the exception that patients with asthma were younger. Approximately 60% of the participants with diabetes were women, and the average age was approximately 55 years. About 25% of these

patients were covered by Medicaid, and 20 to 26% had no insurance.

INDIVIDUAL MEASURES

The percentage of patients who received treatment with an antiinflammatory medication for persistent asthma increased by 14 more percentage points in the intervention centers than in the external control centers ($P<0.01$) and by 8 more percentage points than in the internal control centers ($P>0.05$) (Table 5). The percentage of patients with an asthma management plan increased by 17 more percentage points and by 16 more percentage points in the intervention centers than in the two control groups, respectively ($P<0.001$ for both comparisons). For diabetes, the percentage of patients with two or more assessments of glycated hemoglobin levels increased by 16 more percentage points in the intervention centers than in the external controls ($P<0.001$) and by 12 more percentage points for the comparison with internal controls ($P<0.01$). The only hypertension measure that showed significantly greater improvement in the collaborative centers than in the control centers was the assessment of smoking status and advice about cessation, if appropriate (an increase of 12 percentage points as compared with internal controls, $P<0.05$).

OVERALL EFFECT OF THE COLLABORATIVES

For all three conditions, the intervention centers improved care by an additional 4.9 percentage points as compared with internal controls and by an additional 4.5 percentage points as compared with external controls ($P<0.001$ for both comparisons) (Table 6). The intervention centers also had significant improvement in the composite indicators for prevention and screening, with an increase of 6.2 percentage points as compared with internal controls ($P<0.001$), and an increase of 4.5 percentage points as compared with external controls ($P<0.01$). The composite indicators for disease monitoring and treatment also improved significantly (5.5% for internal controls and 5.9% for external controls, $P<0.001$). However, there was no significant improvement in intermediate outcomes.

Patterns that were similar to the overall findings were observed for centers participating in the asthma and diabetes collaboratives, whereas there was no significant improvement overall or in the composite indicators for disease monitor-

Table 2. Characteristics of Community Health Centers.*			
Characteristic	Intervention Centers	Internal Control Centers	External Control Centers
Overall			
Community health centers (no.)	44	40	20
Region (%)			
Northeast	24	24	25
Southeast	29	27	20
Midwest	22	22	30
West	24	27	25
Urban (%)	48	53	45
Practice sites (no.)	7.0±4.1	8.8±13.1	5.6± 3.8
Patients (no.)	16,843±10,619	16,785±11,735	18,523±13,693
Asthma			
Community health centers (no.)	13	16	19
Region (%)			
Northeast	39	29	26
Southeast	15	14	16
Midwest	15	21	32
West	31	38	26
Urban (%)	54	50	47
Practice sites (no.)	7.4±3.9	9.7±15.1	5.8±3.8
Patients (no.)	19,275±12,648	17,438±13,107	19,115±13,802
Diabetes			
Community health centers (no.)	17	14	18
Region (%)			
Northeast	21	29	28
Southeast	29	29	17
Midwest	21	14	33
West	29	29	22
Urban (%)	47	64	50
Practice sites (no.)	10.9±14.8	6.8±4.2	5.8±3.9
Patients (no.)	18,107±12,562	14,327±6680	19,817±13,849
Hypertension			
Community health centers (no.)	14	10	18
Region (%)			
Northeast	14	11	28
Southeast	43	44	22
Midwest	29	33	33
West	14	11	17
Urban (%)	43	40	44
Practice sites (no.)	5.2±3.9	7.4±4.5	5.6±4.0
Patients (no.)	13,057±6251	20,725±13,909	19,060±14,156

* Plus-minus values are means ±SD. Percentages may not sum to 100 because of rounding.

Table 3. Quality-Improvement Activities Undertaken by Participating Community Health Centers.*

Category	Quality-Improvement Activity	Examples	Mean No. of Activities per Center (range)
Delivery system redesign	Improve care management, missed-appointment follow-up, or organization of the practice team; change care delivery roles; plan patient visits; or otherwise change the basic manner in which visits are or can be carried out	Develop a procedure to reschedule appointments for all patients with asthma who miss appointments Schedule meetings between patients with diabetes and case managers as part of well visits	8.8 (2–15)
Self-care support	Provide education or care guidelines to patients, increase patient motivation for self-care, assess self-care needs or abilities, provide support tools or resources to improve self-care, engage in collaborative decision making with patients	Develop and provide a dietary information sheet for patients with diabetes Add self-care goals to flow sheet in the medical record	7.2 (1–19)
Decision support	Institute guidelines, protocols, and prompts; educate providers; or facilitate specialty and expert consultation to improve individual patient care or the overall practice	Give providers an asthma-severity assessment card to try out as part of the office visit Schedule an in-service session for an asthma or allergy specialist to meet with all providers	6.1 (1–14)
Information support	Develop or improve patient registry systems, improve the collection or use of data for care management, or provide performance data to individual providers or to the group or organization	Develop a registry for patients with hypertension Use a patient registry before a visit to generate a diabetes flow sheet showing previous values and recommended testing	8.8 (3–16)
Community linkages	Access resources (e.g., donated medical services) in the community for the benefit of patients in community health centers or provide services to an entire community (e.g., “Diabetes Awareness Day”)	Obtain free passes from a local gym for patients with diabetes Hold a workshop on hypertension and an education day at a local church	8.8 (1–24)
Health system organization	Increase administrators’ motivation and ability to improve care for patients with chronic disease, increase providers’ motivation and ability to be involved in such improvements, or improve the overall ability of the system or institution to engage in coordinated quality-improvement efforts	Develop a quarterly incentive plan to motivate nurses to provide more diabetes education Ask quality-improvement team leaders to meet with the chief executive officer or chief financial officer to describe progress and promote buy-in for quality-improvement efforts	5.2 (1–12)

* Data are based on reports from 40 of 44 participating community health centers.

ing and treatment or intermediate outcomes composites for participants in the hypertension collaborative.

Overall, there was no significant difference in improvements between the internal and external controls for any of the composite measures we examined. For the individual diseases, the pattern was mixed and did not show consistent evidence of negative or positive spillover effects. (See the Supplementary Appendix, available with the full text of this article at www.nejm.org.)

DISCUSSION

We conducted a large-scale evaluation of an intervention to improve the care at community health

centers for patients who have diabetes, asthma, or hypertension, three prevalent chronic diseases that in aggregate affect more than 25% of the adult population in the United States.²³ A quality-improvement intervention based in community health centers is particularly relevant today because of their substantial growth in both the number of sites and numbers of patients served over the past decade, their prominent role in providing care for members of minority groups and other disadvantaged populations, and President George W. Bush’s stated goal to expand their number in order to increase access to care for the uninsured.

Our study showed that participating in a collaborative improved the processes of care related to prevention and screening and disease monitor-

Table 4. Characteristics of Patients in the Intervention and Control Centers.*

Characteristic	Intervention Centers	Internal Control Centers	P Value	External Control Centers	P Value
Asthma					
Female (%)	63.5	67.6		62.7	
Age (yr)	28.4±18.9	34.4±19.1	<0.05	32.0±20.0	
Race or ethnic group (%)†					
White	41.4	42.9		35.1	
Black	21.3	31.2		19.5	
Hispanic	23.7	16.0		21.9	
Other	13.7	9.9		23.6	
Insurance (%)					
Private	22.0	12.4		21.8	
Medicaid	43.7	40.5		44.0	
Medicare	4.6	13.2	<0.001	9.1	<0.05
Other	6.4	17.7	<0.01	15.4	<0.05
None	23.1	15.5		9.1	
Language other than English (%)	14.3	11.3		25.7	
Charlson comorbidity index‡	0.31±0.70	0.53±1.4	<0.01	0.40±0.88	
Diabetes					
Female (%)	63.5	59.5		60.03	
Age (yr)	54.1±14.1	54.0±13.1		56.5±13.6	
Race (%)					
White	34.7	30.6		34.9	
Black	30.8	15.7		17.6	
Hispanic	24.1	32.5		29.4	
Other	10.3	21.2		18.1	
Insurance (%)					
Private	10.9	13.2		17.4	
Medicaid	24.2	25.2		25.3	
Medicare	29.6	20.0		31.4	
Other	25.6	26.0		20.1	
None	9.3	15.0		5.7	
Language other than English (%)	19.1	40.9		33.8	
Charlson comorbidity index	0.69±1.34	0.58±1.0		0.68±1.17	

ing and treatment for diabetes and asthma, but participating in a collaborative did not improve these processes for hypertension. The study did not show improvements in intermediate outcomes of care. Whether these differences in diseases and outcomes are related to the nature of each targeted condition, aspects of the participating organizations, ease of patient adherence, or the specific collaborative under study is not known. Finally, improvements over time were seen in both inter-

vention and control centers for almost every individual measure. Whether this broad improvement reflects general secular trends²⁰ or the general quality-improvement environment at community health centers is not known.

There are several potential explanations for the lack of effect with respect to intermediate outcomes. First, many of the processes of care that we studied (e.g., retinal examinations for patients with diabetes) are linked to longer-term

Table 4. (Continued.)

Characteristic	Intervention Centers	Internal Control Centers	P Value	External Control Centers	P Value
Hypertension					
Female (%)	56.2	62.8		60.6	
Age (yr)	56.1±13.3	54.4±13.9		58.3±14.3	
Race (%)					
White	52.3	43.5		36.3	
Black	13.2	29.7		21.5	
Hispanic	23.0	22.7		25.2	
Other	11.5	4.2		17.1	
Insurance (%)					
Private	15.7	23.8		18.4	
Medicaid	17.1	13.6		23.1	
Medicare	28.3	24.6		33.2	
Other	9.0	10.1		8.9	
None	29.4	27.8		16.1	
Language other than English (%)	26.0	14.9		29.0	
Charlson comorbidity index	0.87±1.17	0.79±1.07		0.90±1.20	

* Plus–minus values are means ±SD. P>0.05 for all comparisons except where otherwise noted. There were no significant differences between the preintervention and postintervention populations, so these populations were combined for this table.

† Data on race or ethnic group were obtained from medical records.

‡ The Charlson comorbidity index is based on 17 indicators of coexisting conditions, which are weighted and then totaled to provide a single value after elimination of the condition under study. A value of 0 indicates that there are no serious coexisting conditions.

outcomes but are not directly linked to the intermediate outcomes that we examined. For those that are related to intermediate outcomes, the magnitude or importance of the linkage might not be strong. For instance, even though glycated hemoglobin must be monitored in order to achieve and maintain optimal levels, the documentation of this monitoring does not necessarily mean that important changes in management by the clinician or by the patient have been undertaken in response to suboptimal results. In addition, to the extent that the processes of care we examined are linked to these intermediate outcomes, it would be difficult to detect a difference in outcomes solely related to the modest improvements in the processes that we observed. Finally, achieving improvements in both longer-term and intermediate outcomes may require more intensive interventions in order to overcome environmental factors that pose particular challenges for patients treated at community health centers.

A focus on intermediate outcomes may also detract attention from some of the most impor-

tant evidence-based processes that can be improved. For instance, smoking cessation and daily aspirin for men at high risk for coronary artery disease are among the most powerful clinical interventions we measured in this study. Yet the associated outcomes occur in the longer term, and a longer study period and larger sample would be required to document a meaningful effect. This focus on outcomes that can be measured in the short term to the exclusion of important longer-term outcomes may understate the true effect of quality-improvement collaboratives. Moreover, this issue has implications not only for these types of programs but also for other programs that are designed to improve quality, including pay-for-performance and public reporting programs that may divert attention from longer-term improvement.

Several other studies have explored the value of collaboratives for the care of patients with chronic disease.²⁴⁻²⁸ The results of these studies vary. For example, for the care of patients with asthma, one study showed that a quality-improve-

Table 5. Performance on Adjusted Quality-of-Care Measures.*

Measure	Intervention Centers			Internal Control Centers†			External Control Centers‡			Absolute Difference		
	Before Intervention	After Intervention	P Value	Before Intervention	After Intervention	P Value	Before Intervention	After Intervention	P Value	Intervention vs. Internal Control	Intervention vs. External Control	P Value
Asthma												
Prevention and screening	16	25	<0.001	20	25	<0.05	22	28	<0.05	5	4	
Influenza vaccination for patients with no egg allergy	48	51		46	63	<0.001	54	57		-14	0	
Assessment of smoking status and cessation advice	23	47	<0.001	24	33	<0.01	23	27		15	19	<0.001
Monitoring and treatment	61	75	<0.001	66	72		68	69		8	14	<0.01
Assessment of exposure to smoke or other triggers	37	57	<0.001	31	39	<0.05	32	37		12	14	<0.01
Use of asthma management plan	8	27	<0.001	7	8		9	12		17	16	<0.001
Outcomes												
No urgent care or emergency department visit or hospitalization for asthma	82	87	<0.05	83	87	<0.05	87	87		1	5	
Diabetes												
Prevention and screening	56	70	<0.001	45	52		52	69	<0.001	8	-2	
Assessment of smoking status and cessation advice	55	62	<0.05	49	54		52	59	<0.05	2	0	
Dilated-eye examination	25	49	<0.001	29	40	<0.01	21	24		13	21	<0.001
Foot examination (full)	42	61	<0.001	59	50	<0.01	42	55	<0.001	29	6	
Assessment of nephropathy	36	49	<0.001	34	35		32	40	<0.01	12	5	
Influenza vaccination for patients with no egg allergy	11	21	<0.001	8	8		4	4		10	10	<0.01
Dental examination	30	42	<0.001	36	36		41	37		12	16	<0.01
Monitoring and treatment	30	42	<0.001	36	36		41	37		12	16	<0.01
Assessment of glycated hemoglobin level												

Use of ACE inhibitors or angiotensin-receptor blockers in patients with proteinuria	73	73	78	73	73	74	73	74	5	-1
Lipid profile	53	62	<0.01	56	61	67	<0.001	67	<0.001	-2
Use of daily aspirin (age ≥40 yr)	29	47	<0.001	26	38	33	<0.01	33	<0.01	7
Outcomes										<0.05
Control of glycated hemoglobin level (<9.0%)	57	64	<0.01	53	58	66	<0.001	66	<0.001	3
Control of blood-pressure level (≤130/80 mm Hg)	40	46		38	45	48	<0.05	48	<0.05	-2
Control of LDL level	14	26	<0.001	13	23	26	<0.001	26	<0.001	2
Hypertension										
Prevention and screening										
Smoking cessation advice	52	67	<0.001	55	58	60	<0.01	60	<0.01	12
Monitoring and treatment										<0.05
Blood pressure documented at least twice	88	85		89	83	89	<0.05	89		3
Lipid profile	64	75	<0.001	63	71	76	<0.001	76	<0.001	3
Use of daily aspirin (for patients with coronary artery disease)	53	67		52	46	70	<0.05	70	<0.05	20
Use of ACE inhibitors or angiotensin-receptor blockers (for patients with diabetes mellitus or congestive heart failure) or beta-blockers (for patients with coronary artery disease)	77	72		70	67	71		71		-2
Assessment of glycated hemoglobin	31	37		28	36	41		41		-1
Measurement of creatinine	78	80		67	72	86	<0.01	86	<0.01	-3
Outcomes										
Control of blood pressure	46	53	0.05	46	52	63	<0.001	63	<0.001	0
Control of glycated hemoglobin (<9.0%)	66	69		57	72	69		69		-11

* Measures were adjusted for age, sex, race or ethnic group, insurance status, and presence or absence of coexisting conditions. Some numbers were affected by rounding. LDL denotes low-density lipoprotein, and ACE angiotensin-converting enzyme.

Table 6. Adjusted Composite Quality-of-Care Scores for Intervention and Control Centers.*

Measure	Intervention Centers				Internal Control Centers†				External Control Centers‡				Absolute Difference			
	Before Intervention	After Intervention	P Value	% score	Before Intervention	After Intervention	P Value	% score	Before Intervention	After Intervention	P Value	% score	Intervention vs. Internal Control	P Value	Intervention vs. External Control	P Value
All Three Conditions																
Overall	46.0	55.9	<0.001	45.7	50.6	<0.001	48.5	53.8	<0.001	44.9	49.9	<0.001	4.9	<0.001	4.5	<0.001
Prevention and screening	40.5	51.3	<0.001	41.9	46.5	<0.001	39.6	45.9	<0.001	40.2	46.2	<0.001	6.2	<0.001	4.5	<0.01
Monitoring and treatment	47.4	57.4	<0.001	46.1	50.6	<0.001	50.0	54.2	<0.001	49.5	53.7	<0.001	5.5	<0.001	5.9	<0.001
Outcomes	51.5	58.7	<0.001	54.9	61.0	<0.001	59.4	65.8	<0.001	58.9	63.1	<0.001	1.2	<0.001	0.8	<0.001
Asthma																
Overall	38.7	51.7	<0.001	39.3	45.4	<0.001	42.7	45.2	<0.05	37.3	43.9	<0.001	6.9	<0.001	10.5	<0.001
Prevention and screening	29.2	37.1	<0.001	32.2	40.7	<0.001	36.8	41.0	<0.05	34.7	41.4	<0.001	0.7	<0.05	3.6	<0.001
Monitoring and treatment	30.6	48.5	<0.001	30.4	35.1	<0.01	32.8	35.1	<0.01	32.2	35.1	<0.01	13.3	<0.001	15.6	<0.001
Outcomes	80.6	85.9	<0.05	81.1	85.8	<0.05	85.6	85.9	<0.05	85.6	85.9	<0.05	0.7	<0.05	5.1	<0.001
Diabetes																
Overall	38.9	50.1	<0.001	38.6	42.2	<0.001	37.3	43.9	<0.001	37.3	43.9	<0.001	7.5	<0.001	4.5	<0.01
Prevention and screening	39.2	52.0	<0.001	38.2	40.1	<0.001	34.7	41.4	<0.001	34.7	41.4	<0.001	10.9	<0.001	6.1	<0.001
Monitoring and treatment	39.5	50.5	<0.001	42.6	46.6	<0.05	42.2	46.9	<0.01	42.2	46.9	<0.01	6.9	<0.01	6.3	<0.01
Outcomes	37.4	45.4	<0.001	35.2	42.0	<0.001	37.6	46.3	<0.001	37.6	46.3	<0.001	1.2	<0.001	-0.7	<0.001
Hypertension																
Overall	61.8	67.5	<0.001	60.1	63.6	<0.05	63.5	70.3	<0.001	63.5	70.3	<0.001	2.1	<0.001	-1.2	<0.001
Prevention and screening	52.0	63.8	<0.001	54.4	56.8	<0.001	50.0	57.6	<0.01	50.0	57.6	<0.01	9.3	<0.05	4.2	<0.001
Monitoring and treatment	71.2	74.3	<0.001	68.2	69.8	<0.001	71.7	77.7	<0.001	71.7	77.7	<0.001	1.5	<0.001	-2.9	<0.001
Outcomes	47.3	53.7	<0.05	46.5	54.3	<0.05	54.5	63.2	<0.001	54.5	63.2	<0.001	-1.5	<0.001	-2.3	<0.001

* Composite scores were created by averaging the scores for all the measures applicable to each patient. Because the number of applicable measures varied among patients and the proportion met varied among measures, the component scores were standardized to a mean value of 0 and a variance of 1 before averaging. Scores were adjusted for age, sex, race or ethnic group, insurance status, and presence or absence of coexisting conditions. Some numbers were affected by rounding.

ment collaborative made no difference as compared with a control group, whereas another study showed improvement in self-care but not in other measures.^{25,28} For patients with diabetes, there was no effect on quality of care when six intervention centers were compared with control groups affiliated with the same organizations.²⁴ However, a preintervention and postintervention analysis of a quality-improvement collaborative in community health centers in the Midwest showed substantial improvement in the care of patients with diabetes, as compared with national benchmarks.²⁹

Although we evaluated quality-improvement collaboratives based on the Institute for Healthcare Improvement model — the most prevalent and reproducible type of quality-improvement program — many variations on this model and other approaches to quality improvement have been tried.^{30–32} There is still much to learn about the tools and methods for quality improvement and their potential effectiveness.^{33,34} More research would be helpful regarding the operations and effectiveness of individual quality-improvement collaboratives as well as the broad range of organizational factors that can affect their success.^{31–33,35} In addition, although our study did not show evidence of spillover effects, we need a better understanding of the effects of focused quality-improvement interventions on other aspects of care.

Our study was subject to several limitations. First, we were not able to perform a pure randomized trial of the intervention. Instead, we relied on matching and statistical models to adjust for potential confounding variables. Second, although we assessed important markers of the quality of care that were the main focus of the collaboratives, some clinics might have improved areas of care (e.g., patients' experiences) that we did not measure. Third, the collaboratives for the care of

patients with cardiovascular disease were focused on a set of goals broader than just control of hypertension, so there might have been improvement in other areas of care or for other populations with cardiovascular disease that we did not study. Fourth, we included in the study the lead collaborative site at each community mental health center, as well as one additional site. Thus, if the intervention was not fully implemented throughout the center, our study may have overestimated the effect of the intervention. Stratified analyses according to the type of intervention site showed findings that were largely consistent with the primary analyses presented here. Finally, some of the improvements we observed might have resulted from improved documentation, rather than improved care. However, measures that might be more sensitive to the effects of documentation (e.g., smoking-related measures) did not show more improvement than measures that required an action (e.g., the assessment of glycated hemoglobin levels).

The HRSA Health Disparities Collaboratives are an important national initiative to improve the quality of care for underserved populations at community health centers. Our study showed that these collaboratives significantly improved several processes of care without any observed improvement in intermediate outcomes. The substantial room for improvement in the postintervention period suggests the need for continued refinement of these methods.

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