Diabetes mellitus, primarily type 2, is a common chronic illness. Patients with diabetes are routinely cared for in the primary care setting, but up to 50% of them do not receive recommended care.

Improvements in diabetes care have been demonstrated in practices and residency programs that have implemented quality improvement (QI) techniques. However, the amount of improvement is often small and focused on a few items of diabetes care that are under the direct control of a physician.

Real improvement in all parameters of care has been demonstrated in practices that focus on the Chronic Care Model (CCM), a framework for organizing the treatment of chronic illnesses in primary care using evidence-based, multi-component interventions that change the prevailing clinical system of care. These system changes facilitate productive interactions between the care team and the patients, resulting in enhanced patient outcomes.

One method to implement the CCM for diabetes is to use a learning collaborative, originally described by the Institute for Healthcare Improvement (IHI). Learning collaboratives bring together health care organizations committed to implementing major, rapid system changes to improve chronic illness care; the organizations meet together several times for training, goal setting, and planning and then work on system change at their home site. The learning collaborative approach combined with the CCM serves as a roadmap for providing quality patient care and for training family medicine residency sites in systems thinking and practice-based learning, which are two of the six core competencies now required by the Accreditation Council for Graduate Medical Education. No prior residency learning collaborative was reported in the literature at the beginning of this project.

The National Committee for Quality Assurance (NCQA) in conjunction with the American Diabetic Association (ADA) has developed a Physician Recognition Program (PRP) (www.ncqa.org/dprp), a voluntary program to highlight physicians and practices that provide excellent care for people with diabetes. Physi-
The PRP assesses key measures that were defined and tested for their relationship to improved care for people with diabetes. Completion of these targets results in awarding of points (Table 1). At the start of the project, only nine physicians in North Carolina and no residency programs achieved sufficiently high quality of diabetes care to receive the PRP Award. Six family medicine residency programs affiliated with the University of North Carolina (UNC) agreed to work together to improve care for diabetic patients. None of these six family medicine residency programs met the PRP goals in 2002, when this initiative was started.

The objectives for the project included: first, six UNC-affiliated family medicine residency programs would form a learning collaborative; second, each family medicine residency site would meet or exceed at least one of the nine PRP targets for care of diabetic patients that they had not previously met; third, two sites would improve their care of diabetic patients so that they achieve the PRP; fourth, each site would improve their ability to implement the CCM, using a tool known as the Assessment of Chronic Illness Care (ACIC); and fifth, we would identify factors that impede and/or support improvement in diabetes care in family medicine residency settings.

Methods

Description of Residency Sites

The sites involved were six North Carolina family medicine residency programs associated with UNC. One of the six sites was located at a medical university but operated at a separate physical location than the other university primary care residency outpatient clinics. The other five sites were community-based family medicine residency programs. One was a rural family medicine program with a total of six residents, as compared to the usual 24 residents at other sites. At the start of the project, none of the sites were familiar with or using the CCM. Four of the sites used an electronic health record (EHR) to monitor patient outcomes, and two sites were already monitoring a few basic indicators for diabetes care. One site had a strong organizational ability to implement the CCM, using a tool known as the Assessment of Chronic Illness Care (ACIC), and fifth, we would identify factors that impede and/or support improvement in diabetes care in family medicine residency settings.

Diabetes Learning Collaborative

Our learning collaborative, patterned after the IHI model, included a planning group, a coordinator, a physician leader, and six family medicine residency-based diabetes QI teams. The PRP guidelines and the CCM were used as a framework for restructuring diabetes care in the practices and to inform the interventions (Table 2). A project coordinator for the learning collaborative was hired who was skilled in process facilitation and team management. The learning collaborative structure provided assistance to the local residency-based diabetes QI teams with tools and materials to support clinical practice improvement on the selected topic and ongoing support so that the residency program teams could share knowledge and experience with each other.

Table 1

<table>
<thead>
<tr>
<th>Required Measures</th>
<th>Goal</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>HbA1c (most recent result)</td>
<td>93%</td>
<td>NA</td>
</tr>
<tr>
<td>HbA1c &lt; 8%</td>
<td>55%</td>
<td>5.0</td>
</tr>
<tr>
<td>HbA1c &gt; 9.5%</td>
<td>≤ 21%</td>
<td>10.0</td>
</tr>
<tr>
<td>Eye exam</td>
<td>61%</td>
<td>10.0</td>
</tr>
<tr>
<td>Foot exam</td>
<td>80%</td>
<td>10.0</td>
</tr>
<tr>
<td>Blood pressure frequency</td>
<td>97%</td>
<td>10.0</td>
</tr>
<tr>
<td>Blood pressure &lt; 140/90 mm Hg</td>
<td>65%</td>
<td>5.0</td>
</tr>
<tr>
<td>Nephropathy assessment</td>
<td>73%</td>
<td>10.0</td>
</tr>
<tr>
<td>Lipid profile</td>
<td>85%</td>
<td>5.0</td>
</tr>
<tr>
<td>LDL &lt; 130 mg/dl</td>
<td>63%</td>
<td>5.0</td>
</tr>
<tr>
<td>Total points</td>
<td>70.0</td>
<td></td>
</tr>
<tr>
<td>Points to achieve recognition</td>
<td>52.0</td>
<td></td>
</tr>
</tbody>
</table>

NA—not applicable

HbA1c—Hemoglobin A1c. Proportion of the sample that had an HbA1c within 1 year of the clinic visit that qualified them to be in the sample. No points are awarded for achieving this goal.

HbA1c < 8%—percentage of sample with one HbA1c within 1 year of the clinic visit that qualified them to be in the sample, with a result less than 8%.

HbA1c > 9.5%—percentage of sample with one HbA1c within 1 year of the clinic visit that qualified them to be in the sample, with a result greater than 9.5%.

Eye exam—percentage of sample with a dilated retinal examination within 1 year of the clinic visit that qualified them to be in the sample.

Foot exam—percentage of the sample with a foot examination (including monofilament testing) within 1 year of the clinic visit that qualified them to be in the sample.

Blood pressure—percentage of the sample with a blood pressure measurement within 1 year of the clinic visit that qualified them to be in the sample.

Blood pressure < 140/90 mm Hg—within the population with a blood pressure within 1 year of the qualifying visit, the percentage of the population whose most recent blood pressure measurement is < 140/90 (both the systolic and the diastolic must be below their respective thresholds).

Nephropathy assessment—the percentage of the sample with either a urine test for microalbumin or medical care for diabetic nephropathy within 1 year of the clinic visit that qualified them to be in the sample.

Lipid profile—percentage of the sample with a lipid profile within 1 year of the clinic visit that qualified them to be in the sample.

LDL < 130 mg/dl—within the population that had a lipid profile within 1 year of the qualifying visit, the percentage of low density lipoprotein-cholesterol results that are less than 130 mg/dl.
Table 2

Chronic Care Model

The Chronic Care Model consists of six domains that form a cluster of system interventions for primary care practices to meet the needs of chronically ill patients.10

1. **Leadership** demands strong clinical and administrative support and appropriate incentives.

2. **Decision support** refers to assessment tools, treatment guidelines, and specialist support that facilitate the recognition and treatment of chronic disease.

3. **Delivery system design** relates to the organization of care, including providers who have the time to plan, interact, and follow-up with patients; the use of care managers; and innovative scheduling of visits.

4. **Clinical Information System** includes a clinical care registry that facilitates the roles of physicians and care managers by providing timely access to population- and individual-based information about key disease processes, outcomes, planned care, and required follow-up.

5. **Self-management support** organizes strategies for increasing patient knowledge, motivation, empowerment, confidence, and self-management skills.

6. **Community resources** identifies complementary community resources and self-help that, while not a customary service provided by health care practices, do contribute to the effectiveness of the overall model.

**Planning Group**

The planning group was composed of representatives experienced in quality improvement techniques from the family medicine residency programs. The primary task of the planning group was to develop outcome measures patterned after the PRP. This group met once to identify these measures and then revised them by electronic correspondence.

**Training**

The learning collaborative, according to recommendations from the IHI, started with a full-day QI learning session. Prior to training, each of the six North Carolina family medicine residency programs was asked to form local diabetes QI teams. Members of each team included a faculty physician leader, a support staff facilitator, a nurse, a resident, and a business office person. Team members attended a full-day learning session in Chapel Hill, NC, in the winter of 2002 to introduce the CCM, the PRP, QI tools, the process improvement model called FOCUS PDCA (Find, Organize, Clarify, Understand, Select, Plan, Do, Check, Act), and team-building skills.20

**Diabetes QI Teams**

After this training, the teams worked at the local level to design site-specific intervention strategies focusing on six key areas of the CCM that are also the focus of the ACIC instrument described later. These six areas are the community, the health system, self-management support, delivery system design, decision support, and clinical information systems.

The resulting interventions consisted of diabetic registries,21 computerized flow sheets and chart prompts,4 self-management programs for diabetic patients,22 task delegation to nursing staff and lab personnel, scheduling regular every-3-month appointments for routine diabetes care, and feedback of individual physician data for their diabetic patients.

To provide ongoing technical assistance to the practices, the physician leader and the project coordinator of the learning collaborative held structured conference calls with one staff person from each diabetes QI team every 4 weeks to review practice-specific activities, successes, barriers to improvement, strategies for engaging and training residents, and common themes. In addition, the project coordinator shared various tools such as flow sheets, standardized patient letters, and group visit protocols identified from outside sources. A final teleconference session was held in December 2003 to review activities, data, and successes from each of the practices.

**Data Collection**

There were two data collection efforts at each site, one to measure progress toward the nine target indicators of the PRP and the other to measure progress toward full development of the chronic care model in addressing diabetes care.

Baseline practice data collection for the PRP occurred in December 2002, implementation of the interventions took place in early 2003, and follow-up data on the specified diabetic care variables occurred in December 2003. For the one site that was demonstrating substantial progress, the data were voluntarily reported again in August 2004.

The grant support and the agreement with the sites ended the learning collaborative in December 2003. Based on instructions from the PRP, each clinical site was asked to identify patients with diabetes through administrative records and *International Classification of Diseases, Clinical Modification, Ninth Edition* (ICD-9) diagnostic code (250.xx, 357.2, 362.0–362.0x, or 366.41) or patient registries and to then perform chart reviews on 210 patients ages 18 and older. Four of six sites used EHRs to gather patient data. An office staff person in each practice followed the specified instructions for the patient variables from the PRP, as listed in Table 1. The sample of patients included continuity patients for at least 1 year with a diagnosis of diabetes at least 12 months prior to the baseline start date.

The ACIC is a survey developed from specific evidence-based interventions for the six components of the CCM described earlier (Table 2).19 It is intended...
to be used to identify areas for improvement in care for chronic illness before beginning QI work and to evaluate the level and nature of improvements made in response to interventions. Each section has five or more questions using a Likert response format (0 for limited support to 11 for fully developed support), each section’s score is averaged, and then a final average score is obtained. Scores reported in the literature for practices beginning their participation in collaboratives range from 4.4 to 6.4.19 Individual team members from six sites completed the survey instrument at the beginning of the learning collaborative, and individual team members from five sites completed the ACIC at the end.

Data Analysis

Outcome evaluation focused on the achievement of each of the parameters of diabetes care patterned after the PRP (Table 1) and whether the sites achieved the project objectives. The average baseline and follow-up ACIC scores for each site are reported (Table 3).

Results

Baseline practice data were collected from 1,203 diabetic adult patients from six practices, and follow-up data were collected on 1,262 patients from five sites. Four of six sites met or exceeded at least one PRP target for diabetes care that they had not previously met, although one of those sites regressed in one of the target variables (Table 3). Three of six sites met or exceeded two diabetic targets that they had not previously met.

Site A improved enough to be eligible for the Recognition Award (Table 3). Two sites needed to meet or exceed two or more additional targets to achieve this goal.

Table 3 lists interventions by site and resultant PRP and ACIC scores.

Each practice received monetary support to travel to the initial training session and then money to offset some of the time required for participation ($3,000 per site). For each site, participation averaged 8 hours of initial training for four people, 4 hours of staff time per month over 12 months to participate on the QI
team, 1 hour of staff time over 12 months for learning collaborative phone calls, 15 hours of additional data manager time for collection of before and after patient data, and 4 hours of four staff to participate in the final teleconferencing session—overall 123 hours of staff time, of which 24 hours involved the local faculty physician representative. The physician leader of the learning collaborative spent approximately 10 hours in preparation for the initial and follow-up training sessions and then 2 hours each month while the coordinator spent 10 hours preparing for the two training sessions and 4 hours each month on the program.

Problems and Challenges
Clear themes emerged when we reviewed the self-reported challenges encountered during the implementation of interventions. Problems with the EHRs included technical limitations such as an inability to flash reminders to physicians to perform certain patient services and cumbersome numbers of key strokes required by physicians to enter information into flow sheets, resulting in incomplete patient information extracted from the EHR. The ophthalmologists and optometrists were not willing to use a standardized reporting form. Staffing changes within the sites stalled, and in some cases derailed, the QI teams’ progress; complicated resident schedules did not encourage participation by these learners. Larger organizational issues created the most difficult barriers. These ranged from the organization failing to support the QI teams’ suggestions to the organization’s desire to focus on improving access to same-day appointments rather than diabetic quality of care.

Discussion
Study Findings
Our findings are similar to those published by the Diabetes Health Disparities Collaborative, who trained community health centers in QI techniques, system changes in health care delivery, and local practice-based improvements in diabetes care. Collaboratives in Washington, North Carolina, and the Midwest demonstrated significant improvement in rates of HbA1c measurement, eye examination referral, foot examination, and lipid assessment.13-16

Our site A improved beyond the point score needed to receive the PRP award. Compared to the other sites, they had a stronger QI culture with an infrastructure supporting faculty and resident participation, strong faculty leadership, substantial resident involvement and accountability on the QI team, and implemented many types of interventions aimed at almost all of the six elements of the CCM.

Lessons Learned
A strong organizational foundation with active physician leadership appears to make an organization more effective than organizations without systematic institutionalization of QI principles at implementing change and achieving the goals of the CCM and the learning collaborative.14,17

Several practices had trouble engaging regular resident participation on the diabetes QI teams. Those sites that were successful had a strong faculty-led QI culture, clearly stated requirements for formal resident participation in QI activities, identified an afternoon a week for didactic teaching sessions, and held diabetes QI team meetings during that protected time.

Competing demands, such as transitioning to an EHR or reorganizing the patient care schedule to accommodate an open access system, can drain resources from activities focused on quality of care. Quality of care is still viewed as being of lesser importance than the business of medical practice.

Limitations
Traditionally, the IHI requires health care organizations to purchase participation in learning collaboratives and requires the presence of the local staff at three 2-day IHI conferences (rather than our two 1-day conferences).10 We elected to use internal leaders as the teachers, to streamline the number and length of conferences, and to provide monetary reimbursement to the sites for participation; these modifications might have diluted the outcomes.

The ACIC instrument is fairly new and has not been used extensively enough to determine whether small increases in numerical scores truly represent significant improvements in diabetic care.19 Additional work is underway to define clinically meaningful change in ACIC scores—that is, the minimally significant score change related to actual improvements within the system and patient outcomes (www.improvingchroniccare.org). The improvement in the target scores on the PRP diabetic variables suggests that the improved scores on the ACIC instrument may be real. Further, it would have been useful to have used a tool to gauge leadership commitment, organizational priority including competing interests, and history of successful system change efforts.

The largest challenge we faced was the need to totally revolutionize care for diabetic patients, with improvement needed in as many as eight of the nine areas. The duration of our learning collaborative may have been too short for practices to reach the PRP goals. In addition, all of the sites function in predominantly fee-for-service medical environments where individual patient visits are reimbursed. Reorganization of practices to achieve better diabetes care as measured by the PRP targets is not specifically reimbursed and financial incentives are not aligned with reaching these targets.
Conclusions

Our learning collaborative structured the residency programs to focus on evaluating diabetes care, reporting practice activities and progress to a group of peers on a regular basis, and summarizing their challenges/successes for a wider audience. Without this effort the practices stated that they would not have done these activities.

The residency site that was the most successful in improving their diabetic care demonstrated significant leadership commitment and an organizational priority for chronic disease management; thus, residency sites may need to focus on these issues prior to the use of a learning collaborative to better achieve the desired patient outcomes. Learning collaboratives, by enrolling multiple clinical practices, allow interventions, challenges, and successes to be shared quickly and directly with many other practices, as compared to traditional QI techniques. This network of practices in the learning collaborative demonstrates normative behaviors that practices seek to emulate. Thus, they may provide a cost-effective method for residency programs to be trained in QI techniques, to learn about the CCM, and to achieve better care for diabetics than with traditional QI techniques.

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