

Improving Care in a Resident Practice for Patients With Diabetes

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Abstract

Background Curricular redesign and introduction of the Chronic Care Model in our residency clinic during 2005–2007 achieved limited success in glycemic (glycated hemoglobin level [A_{1c}]), lipid (low-density lipoprotein fraction [LDL]), and blood pressure (BP) control for patients with diabetes.

Intervention Beginning in January 2008, ancillary staff performed previsit, protocol-driven reviews of medical records of patients with diabetes to identify those not at A_{1c} , LDL, and BP goals; inserted electronic prompts into the records regarding deficiencies; and obtained samples for A_{1c} or lipid panel when needed. Faculty feedback regarding resident-specific panel reviews was added in May 2008, and point-of-care A_{1c} testing was implemented in February 2009.

Methods We conducted a 2-year retrospective study of all patients at our facility with diabetes mellitus, who had at least 1 visit during January to June 2008 (baseline) and 1 visit during July to December 2009 (follow-up). Measures included the most current A_{1c} , LDL, and BP results. Paired outcome results were compared using the McNemar χ^2 test.

Results A total of 522 patients with diabetes mellitus were seen during the baseline and follow-up periods, and 456 patients (87.4%) had paired A_{1c} results, with $A_{1c} < 7.0\%$ for 138 of 456 patients (30.3%) at baseline and 166 of 456 patients (36.4%) at follow-up ($P = .011$). For LDL, 460 patients (88.1%) had paired results, with LDL < 100 mg/dL for 225 of 460 patients (48.9%) at baseline and 262 of 460 patients (57.0%) at follow-up ($P = .004$). A total of 513 patients (98.3%) had paired BP results in which the BP $< 130/80$ mm Hg for 124 of 513 patients (24.2%) at baseline and for 188 of 513 patients (36.6%) at follow-up ($P < .001$). There were 421 patients (80.7%) with paired results for all 3 measures, with 17 of 421 patients (4.0%) at goal at baseline and 41 of 421 patients (9.7%) at goal at follow-up ($P = .001$).

Conclusion The interventions resulted in statistically significant improvements in the proportion of patients with diabetes who attained goal for A_{1c} , LDL, and BP levels. Our redesign elements may be useful in enhancing resident education and in improving patient care.

Background

Evidence-based guidelines for care of patients with diabetes are well established,^{1,2} yet adherence is low.^{3–5} The Chronic Care Model (CCM) uses a multidisciplinary team⁶ to improve care processes and clinical outcomes for patients with chronic illnesses.^{7,8} Organizational and curricular

changes in ambulatory care are needed to improve resident training in team-based models of care.^{9–11}

Our residency program was introduced to the CCM through participation in the Academic Chronic Care Collaborative¹² in 2005–2006. Involvement in the Academic Chronic Care Collaborative was the impetus for the development of a structured curriculum for residents, for practice redesign with an expanded role for nonphysician staff, and for implementation of an electronic medical record and diabetes registry^{13,14} (TABLE 1 a). After assessing the effectiveness of the program in 2006 with a sample of 150 patients, this model of care was applied to all patients with diabetes in our resident clinic as part of the Residency Review Committee–Internal Medicine’s Educational Innovation Project. The intermediate clinical outcomes for glycated hemoglobin level (A_{1c}), low-density lipoprotein fraction (LDL), and blood pressure (BP) were slow to improve. Small sample studies by residents in our program identified many missed opportunities to intensify treatment during clinic visits when patients were not at their goal. Lack of readily available decision support during

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TABLE 1a CARE DELIVERY REDESIGN ELEMENTS USING THE CHRONIC CARE MODEL 2005–2007

Provider Team	Defined Role
Clinic secretary	Identify appointments of patients with diagnosis of diabetes mellitus
Medical assistant	Measure blood pressure at visit Perform phlebotomy during visit if ordered
Nurse practitioner and pharmacist	Provide comprehensive protocol-guided diabetes care visits Maximum 15 such visits per week for each of 2 nurse practitioners and 1 pharmacist
Faculty	Structured chronic care curriculum: ▪ Individual and small group (2–4 residents) educational sessions 4 times per month, 1 month per year for each resident ▪ Algorithms focused on glycemic, lipid, and blood pressure control ▪ Electronic flow sheet that tracks elements of care (foot exams, ophthalmology exams, laboratory tests, immunizations, smoking cessation, self management goal setting) ▪ Podcasts for asynchronous learning ▪ Monthly interdisciplinary team meetings to discuss patients selected by the residents ▪ Monthly practice-redesign meetings to identify strategies for improvement
Research assistant	Populate patient flow sheets with predetermined elements of care Prepare monthly panel reports for overall clinic population
Resident	Annually complete the chronic care curriculum by level of training Identify and order/perform needed patient tests and interventions Intensify care when appropriate, using algorithms as needed

visits, difficulty with accessing recent laboratory test results, and absence of cues related to abnormal results during all visits were identified as barriers to intensification of care.

A series of interventions (shown in TABLE 1b) were implemented in January 2008. The aim for those interventions was to increase the proportion of patients with diabetes who were at goal levels for A_{1c}, LDL, and blood pressure and to expand the experience of residents in successful team-based patient care. The interventions expanded the role of care-delivery team members and applied that approach to all visits by patients with diabetes. The residency's chronic care

curriculum was expanded to enhance residents' experiences with team care. In February 2009, point-of-care A_{1c} testing was added to address inefficiencies caused by delayed reporting of results (TABLE 1c). The flow diagram illustrated in Figure 1 provides a timeline of when each change was initiated.

Methods

Setting

The Internal Medicine Center is the continuity clinic for the internal medicine residency program at Summa Health

TABLE 1b TEAM-BASED CARE FOR ALL VISITS BY PATIENTS WITH DIABETES—IMPLEMENTED JANUARY 2008

Provider Team	Expanded Role
Registered nurse	Review chart with previsit protocol, adding chart prompts for visit Sample prompts: ▪ Results for A_{1c} and lipid panel are needed ▪ A_{1c}, lipid panel, and/or blood pressure are not at goal; consider intensification
Medical assistant	Assess blood pressure at visit, add protocol-driven chart note to prompt consideration of intensification if not at goal
Phlebotomist	Obtain sample for A _{1c} and lipid panel when needed
Research assistant	Prepare resident-specific panel reports Track results of small tests of change (Plan-Do-Study-Act cycles) with reports sent to redesign team
Faculty	Expand chronic care curriculum to include ▪ Annual individual review of resident-specific panel reports with that resident ▪ Oversight of redesign team with focus on intensification of care methods
Resident	Review clinical information and intensify treatment using algorithms Respond to electronic prompts entered in patient record

TABLE 1c TEAM-BASED CARE FOR ALL VISITS BY PATIENTS WITH DIABETES—IMPLEMENTED FEBRUARY 2009	
Provider Team	Expanded Role
Medical assistant	Perform point-of-care A _{1c} testing, add protocol-driven chart note to prompt consideration of intensification if not at goal levels

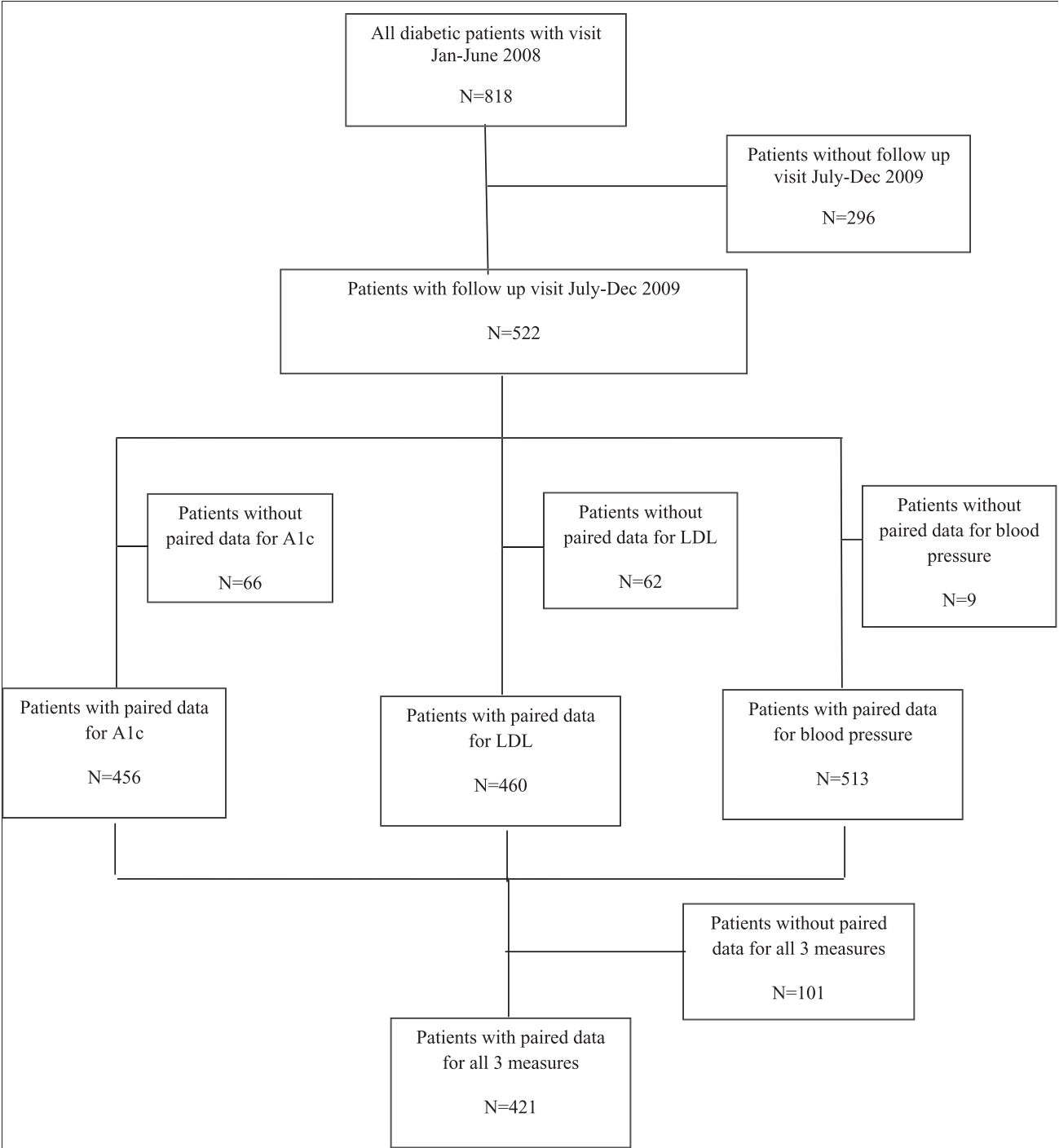
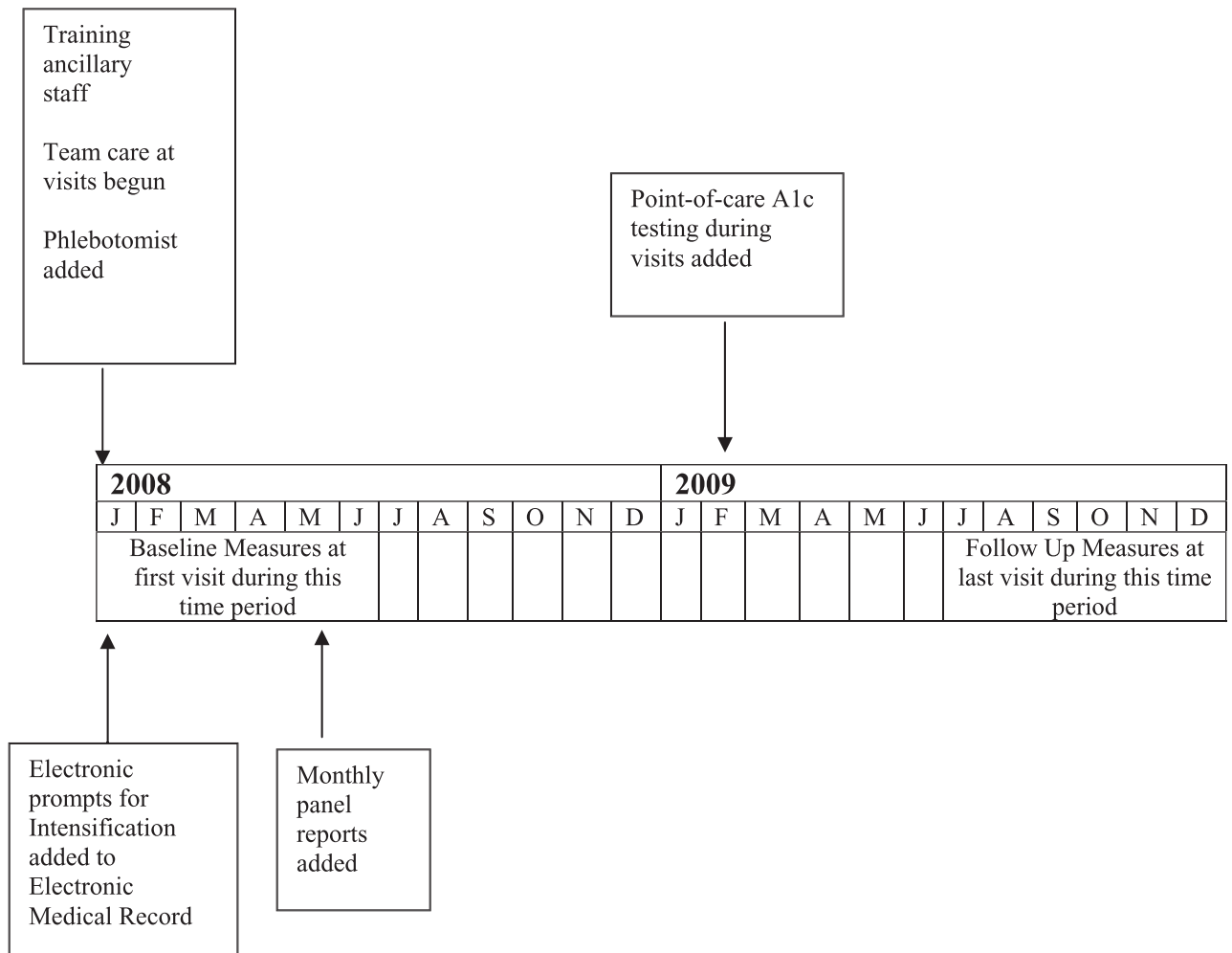


FIGURE 1 | TIMELINE FOR IMPLEMENTATION OF INTERVENTIONS

Service Redesign



Curriculum Expansion

FIGURE 2 | DESCRIPTION OF SAMPLE SELECTION FOR OUTCOMES ANALYSIS

System, a major teaching hospital of the Northeastern Ohio Universities College of Medicine. The center provides care for approximately 7000 patients living in the greater Akron, Ohio, area and is staffed by 48 residents, 16 internal medicine faculty physicians, 2 nurse practitioners, and 1 pharmacist. Eleven faculty physicians have their own patient panels and typically see their patients no more than 1 half-day per week. The other 5 faculty members do not have their own patient panels and serve as preceptors in the center. Nurse practitioners and the pharmacist do not have their own patient panels but provide comprehensive diabetes visits, as well as acute and urgent visits for patients of the faculty and residents. Faculty physicians represented approximately 1 clinical full-time equivalent physician, and the 48 residents represented 9 clinical

full-time equivalent physicians. Faculty and residents have patients with diabetes on their panels. Each resident provides continuity care for a panel of 100 to 200 patients during 3 years of training. A phlebotomist was assigned to the center in January 2008.

Study Design

A retrospective study design was used to assess the effectiveness of these interventions, measured by a statistically significant increase in the proportion of patients with A_{1c} levels $<7.0\%$, LDL fractions <100 mg/dL, or BP $<130/80$ mm Hg after implementation. Summa Health System's Institutional Review Board designated the project as quality improvement and exempted it from review.

Patient Population

The study sample included all patients seen in the Internal Medicine Center during January to June 2008 (baseline visit) with a diagnosis of diabetes mellitus (codes 250.xx, *International Classification of Diseases, Ninth Revision*) who also had at least 1 visit during July to December 2009 (follow-up visit). All visits with a faculty physician, resident, nurse practitioner, or pharmacist were considered for inclusion, with 87% of the patients having a resident physician. There were 818 patients with diabetes who had at least 1 visit to the resident clinic during the baseline period, and 522 of these (63.8%) returned during the follow-up period (FIGURE 1). The 522 patients included in the sample had 4877 visits during 2008–2009 for an average of 4.7 visits per patient per year. Patient measures at the first visit during the baseline period were designated *baseline*. Patient measures at the last visit during the follow-up period were designated *follow-up*. Baseline measures for A_{1c}, LDL, and BP were analyzed for the 296 patients excluded from the sample because they did not have a follow-up visit in the specified time period in 2009 to determine whether this exclusion introduced bias. No major differences were found. Mean A_{1c} levels and LDL fractions were nearly identical. Mean systolic and diastolic BP were slightly lower in patients with no follow-up visit.

Measures

The target goals for glycemic, lipid, and blood pressure control were based on the American Diabetes Association standards at the beginning of our study.¹ Glycemic control was defined as an A_{1c} < 7.0%. Baseline and follow-up A_{1c} values were determined as the most recent result obtained between 6 months before and 1 month after the visits. Lipid control was defined as an LDL < 100 mg/dL. Baseline and follow-up LDL values were determined as those obtained between 1 year before and 1 month after the visits. Hypertension control was defined as a BP < 130/80 mm Hg. Baseline and follow-up BP values were those obtained during visits. A standard chart-review template was used to collect relevant visit-specific laboratory values from the electronic medical record. The A_{1c} and LDL testing were performed by the hospital laboratory or other national laboratories, except for the point-of-care A_{1c} testing, which began in February 2009. Point-of-care A_{1c} levels were measured using a Siemens DCA Vantage analyzer (Siemens Healthcare Diagnostics, Deerfield, IL), which is correlated to high-performance liquid chromatography testing and has been deemed to have traceability to the Diabetes Control and Complications Trial reference method.¹⁵ We used the external proficiency testing program of the American Academy of Family Physicians Proficiency Testing program for office laboratories and used controls with each lot number and shipment of reagents.

TABLE 2 CHARACTERISTICS OF PATIENTS IN THE SAMPLE	
Characteristics	Patients (N = 522)
Women, %	60.7
Age, mean (SD), y	58.5 (12.5)
▪ >65 y, %	31.6
Race or ethnic group, %	
▪ White	49.4
▪ Black	47.7
▪ Other	2.9
Married, %	23.6
Insurance, %	
▪ Private/other	7.9
▪ Medicare/Medicaid	23.2
▪ Medicaid	21.6
▪ Medicare	25.5
▪ None	21.8
Unemployed if <65 y old, ^a %	74.2
Resident as primary care physician, %	87

^a Patient and guarantor of payment unemployed.

Analysis

Proportions of patients achieving glycemic, lipid, and blood pressure control at baseline and follow-up were compared to assess improvements. Each outcome (A_{1c}, LDL, and BP) was analyzed separately, and all patients with complete data for baseline and follow-up in an individual outcome were included in the analysis. FIGURE 2 shows the distribution of patients included in the study and the number of patients included for analysis in each outcome. The SPSS version 17 (SPSS Inc, Chicago, IL), nonparametric, 2-related samples McNemar test was used to complete the analysis. The continuity-corrected χ^2 is reported with an α level of .05 established for significance testing.

Results

Course of the Intervention

Our quality-improvement strategy involved rapid cycles of change. Ancillary staff training took place during a 30-minute group session. The electronic medical record and registry were used to prepare reports of monthly outcomes for all members of the patient-care team. Problems with process and outcomes were discussed by the interdisciplinary redesign team, which initiated further changes to increase the effectiveness of the intervention.

TABLE 3 PROPORTIONS OF PATIENTS AT GOAL FOR GLYCEMIC (GLYCATED HEMOGLOBIN LEVEL [A_{1c}]), LIPID (LOW-DENSITY LIPOPROTEIN FRACTION [LDL]), AND BLOOD PRESSURE (BP) CONTROL

Laboratory Test	Proportion at Visit		P Value
	Baseline (2008), No. (%)	Follow-Up (2009), No. (%)	
Glycemic control ($A_{1c} < 7.0\%$), n = 456	138 (30.3)	166 (36.4)	$\chi^2_1 = 6.509$; $P = .011$ (continuity correction, McNemar test)
Lipid control (LDL < 100 mg/ dL), n = 460	225 (48.9)	262 (57.0)	$\chi^2_1 = 8.151$; $P = .004$ (continuity correction, McNemar test)
Blood pressure control (BP < 130/80 mm Hg), n = 513	124 (24.2)	188 (36.6)	$\chi^2_1 = 22.298$; $P < .001$ (continuity correction, McNemar test)
Glycemia, lipids, and blood pressure all controlled, n = 421	17 (4.0)	41 (9.7)	$\chi^2_1 = 10.580$; $P = .001$ (continuity correction, McNemar test)

Sample Characteristics

TABLE 2 provides a description of the characteristics of the 522 patients included in the sample. The average age was 58.5 years, and 60.7% were women. Blacks and non-Hispanic whites were equally represented. Although most patients were covered by Medicare or Medicaid, 21.8% (114 of 522) had no insurance, and 74.2% of the patients younger than 65 years were not employed nor was the guarantor of payment for the patient's medical bill employed.

Outcomes

TABLE 3 provides an overview of the changes in glycemic, lipid, and blood pressure control from baseline to follow-up. The proportion of patients with $A_{1c} < 7.0\%$ increased from 30.3% at baseline to 36.4% at follow-up ($P = .011$). The proportion with LDL < 100 mg/dL increased from 48.9% at baseline to 57.0% at follow-up ($P = .004$), and the proportion with BP < 130/80 mm Hg increased from 24.2% at baseline to 36.6% at follow-up ($P < .001$). At follow-up, 9.7% of the patients were at goal for all 3 measures, compared with 4.0% at baseline ($P = .001$).

Discussion

After implementation of our interventions, we were able to document statistically significant improvement in outcomes for glycemic, lipid, and blood pressure control in a sample of patients with diabetes receiving care in our resident clinic. The interventions included (1) team changes, with staff reviewing, prior to the visit, the electronic medical records for all patients with diabetes to determine whether they had achieved the nationally recognized goals for A_{1c} , LDL, and BP; (2) addition of electronic prompts in the electronic medical record for patients not at goal; (3) additional laboratory support, including the introduction of point-of-care A_{1c} testing during visits; and (4) expansion of the chronic care educational curriculum by adding faculty review of resident-specific panel reports to reinforce the use of treatment-intensification algorithms.

Successful application of the Chronic Care Model to all patients with diabetes in our resident clinic resulted in a training paradigm using measured quality outcomes and evidence-based medicine to drive care system improvements. The greatest challenge during this process was a general resistance to change. We overcame this by engaging all team members in the redesign process and providing the entire team with feedback regarding changes in measured processes of care and patient outcomes. The availability of data from small tests of change helped us to select those service-redesign options most likely to have a positive effect when applied to the entire clinic. This information, particularly the resident-specific panel data, helped to achieve buy-in from residents and faculty who were skeptical of the benefits of the new model. Resident involvement has been identified by others as being critical to the success of redesigns in residency clinic practice.¹⁶ We felt resident involvement was particularly important in the redesign because of their intimate knowledge of the workings of the resident clinic and the importance of providing future physicians with the best possible training to allow them to provide optimal care throughout their careers.

Although there was a statistically significant improvement in the number of patients achieving A_{1c} , LDL and BP goals, the percentage of patients reaching all 3 targets was relatively low (9.7%). This finding is lower than the national average of 12.2% estimated by the most recent study published on the National Health and Nutrition Examination Survey,¹⁷ possibly because of differences in the socioeconomic status of our patients and those in the national sample. Reports^{3,16,18} from settings similar to ours have demonstrated 6.6% to 17.1% of patients reaching targets for all 3 outcomes. Future efforts in our clinic will focus on intensification of care for patients who have successfully reached one target, which may be one way to improve overall clinical outcomes.

Our study has some limitations, including its single-site design. At the same time, the redesign Plan-Do-Study-Act

methodology we used was developed from our work with the Academic Chronic Care Collaborative and has been used to introduce change at other academic medical centers.^{8,19}

Because several interventions were implemented concurrently, we cannot be certain which one(s) had the greatest effect. Without a control group, other factors (such as lifestyle counseling and medication adherence) could have been responsible for the changes observed, and with a single-group design, regression to the mean could have influenced our results. Our study only included those patients with diabetes who had at least one visit during the first half of 2008 and at least one visit during the second half of 2009, which increases the probability that less-adherent patients were excluded from analysis. Despite these limitations, our resident clinic redesign has demonstrated that statistically significant improvements in A_{1c}, LDL, and BP control can be achieved by patients with diabetes in a setting in which it is challenging to realize goals for improvement.²⁰ This quality improvement initiative also provided opportunities for engaging residents in outcomes-driven practice redesign at an experiential level. The relatively simple changes in care delivery may be transferrable to other residency clinics and may serve to improve outcomes for future patients of our graduates. Future research should confirm our findings through the use of a matched control group or a randomized, controlled trial design to reduce the possible influence of external factors. Future studies could also focus on improving the rate of follow-up and on patient satisfaction, which could have a positive influence on follow-up and adherence to care.

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The following are corrections to the June 2011 issue.

1. Sullivan GM. A primer on the validity of assessment instruments. *J Grad Med Educ.* 2011;3(2):119–120.

On p 119, the sentence should read: Cronbach alpha calculates correlation among all the variables, in every combination, and generates one number that the closer it is to 1, the higher the reliability estimate.

2. Salem JK, Jones RR, Sweet DB, Hasan S, Torregosa-Arcay H, Clough L. Improving care in a resident practice for patients with diabetes. *J Grad Med Educ.* 2011;3(2):196–202.

The Figure legends should read:

Figure 1 Description of Sample Selection for Outcomes Analysis

Figure 2 Timeline for Implementation of Interventions

3. Saeed F, Majeed MH, Kousar N. Easing international medical graduates entry into us training. *J Grad Med Educ.* 2011;3(2):269.

The lead author's name is Fahad Saeed, MD.

4. Sweeney A, Stephany A, Whicker S, Bookman J, Turner DA. Senior Pediatric Residents as Teachers for an

Innovative Multidisciplinary Mock Code Curriculum. *J Grad Med Educ.* 2011;3(2):188–195.

The Figure 3 label for the seventh column is: Communicating Effectively.

5. Le-Bucklin KT, Hicks R, Wong A. Impact of a Teaching Rotation on Residents' Attitudes Toward Teaching: A 5-Year Study. *J Grad Med Educ.* 2011;3(2):253–255.

The Results section of the Abstract should read:

Results: Four categories showed significant improvement, including feeling prepared to teach ($P < .0001$), having confidence in their teaching ability ($P < .0001$), being aware of their expectations as a teacher ($P < .0001$), and feeling that their anxiety about teaching was at a healthy level ($P = .0037$). There was an increase in the level of enthusiasm, but the P value did not reach a significant range ($P = .12$). The level of enthusiasm started high and was significantly higher on the pretest than every other tested category ($P < .0001$).

Footnote c to Table 2 should read: P value as calculated using the Mann-Whitney U test.