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Community-Based Primary Care: Improving and Assessing Diabetes Management

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Morbidity and mortality associated with diabetes make it a prime target for quality improvement research. Quality gaps and racial/gender disparities persist throughout this population of patients necessitating a sustainable improvement in the clinical management of diabetes. The authors of this study sought (1) to provide a population perspective on diabetes management, and (2) to reinforce evidence-based clinical guidelines through a Web-based educational module. The project also aimed to gain insight into working remotely with a community of rural physicians. This longitudinal pre-post intervention study involved 18 internal medicine physicians and included 3 points of medical record data abstraction over 24 months. A Web-based educational module was introduced after the baseline data abstraction. This module contained chapters on clinical education, practice tools, and self-assessment. The results showed a sustained improvement in most clinical outcomes and demonstrated the effectiveness of using Web-based mediums to reinforce clinical guidelines and change physician behavior. (Am J Med Qual 2009;24:xx-xx)

Keywords: diabetes; quality improvement; community based; Web based

The incidence of type 2 diabetes mellitus is rising at an unprecedented rate in the United States; national estimates report an incidence of 1.6 million cases of diabetes each year.[1] Type 2 diabetes accounts for 90% to 95% of these cases.[1] From 1990 to 1998, the prevalence of diabetes increased by more than 30%, from 4.9% to 6.5% of the adult population, affecting an estimated 17 million Americans.[2,3] Diabetes was listed as the seventh leading cause of death in 2006 and is suspected of being underreported.[1] The Centers for Disease Control and Prevention (CDC) reports warn that the risk for death among individuals with diabetes is twice that of individuals without diabetes. Complications of the disease include heart disease, stroke, hypertension, blindness, renal disease, nervous system disease, amputations, dental disease, and complications of pregnancy.[1] Often, the management of these comorbid conditions complicates the management of diabetes. It is estimated that for people aged 65 and older, heart disease was noted on 65% of diabetes-related death certificates, and stroke was noted on 16% of diabetes-related death certificates.[1]

The economic toll of diabetes is also evident. Approximately 17% of all hospitalizations in 2005 involved a diagnosis of diabetes.[4] In 2007, the CDC reported estimated total costs in the United States to be $174 billion, $116 billion of which is attributed to direct medical costs.[1] Research has shown

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that enhanced diabetes patient management can significantly improve the health of patients, which may in turn reduce a percentage of the economic burden. Factors such as regular eye exams, better blood glucose control, foot exams at checkups, and improved cholesterol and blood pressure (BP) control all contribute to reducing a patient's risk of developing diabetic complications. However, the application of these "best practices" in the clinical setting is often suboptimal and ineffective.[5]

Diabetes is a common target condition for quality improvement efforts because of its widespread prevalence, high degree of morbidity and mortality, and evidence that current care falls below expected standards.[6-8] Diabetes is one of the core target conditions underscored in the Institute of Medicine's *Quality Chasm* report, in *Healthy People 2010*, and in many pay-for-performance or pay-for-reporting programs.[6,9,10] Numerous studies have demonstrated the importance of systematic monitoring of indicators, which are reflected in clinical practice guidelines. However, formulation of guidelines alone cannot improve practice; the challenge is in the implementation.[11]

CONCEPTUAL DESIGN

To improve the translation of guidelines into practice, ACPNet* staff designed a quality improvement project to examine the feasibility of disseminating clinical guidelines using an electronic module based on the most current performance measures for primary care practice. This need for a more effective translation of guidelines into practice was articulated in the Institute of Medicine's 2003 report, *Priority Areas for National Action: Transforming Health Care Quality.*[12] This project also drew on the concept of translational research, defined as "comprehensive applied research that strives to translate the available knowledge and make it useful in everyday clinical and public health practice." Three important facets of translational research incorporated into this project include (1) understanding barriers to implementation, (2) studying generalizability, and (3) evaluating sustainability.[13]

To reinforce the translation of guidelines into practice, a quality improvement component was built into the project. Two quality improvement strategies that were adapted from the Cochrane Effective Practice and Organization of Care group and incorporated into this study were audit and feedback, and clinician education.[14] This project also incorporated the premise of adult learning theory, which describes successful adult education as learner-centered, interactive, relevant, engaging, and reinforcing. In concordance with this, research has shown that the most effective techniques for influencing the practices of physicians include reminders, interactive sessions such as workshops, personal office visits by professionals aimed at changing physician behavior (academic detailing), and multiple reinforcing interventions, especially if they are coupled with physician-specific feedback.[15] The methodologies used in this project incorporated a number of these techniques and allowed us to assess actual practice patterns in the ambulatory clinical care setting.

METHODS

Research Design

The primary research goal for this study was to examine the impact of the educational intervention on clinical outcomes in patients with type 2 diabetes. This project used a 2-pronged approach to facilitate quality improvement: (1) It provided a population perspective on diabetes management through aggregation of clinical data on different levels, and (2) it reinforced evidence-based clinical guidelines through a Web-based physician education module enhanced with diabetes management tools and patient education resources.

The study sample included a 112-physician Physician Health Organization in Pennsylvania. It was located in a community with 1 hospital (20 miles in any direction to the next nearest hospital) and represented 95% of all physicians in a 12-mile radius serving approximately 30 000 people. This longitudinal study was conducted using a pre-post intervention design. There were 3 points of data abstraction: 1 preintervention to establish a baseline (phase 1) and 2 postinterventions to test the effectiveness of the intervention and sustainability at 18 months post baseline (phase 2) and 24 months post baseline (phase 3).

The unit of analysis for the study was the physician; 18 internal medicine physicians participated

*ACPNet is the American College of Physicians' quality improvement network.

in the study and generated a list of all diabetes patients who met the patient inclusion criteria. Patients included in this study were those who were diagnosed with type 2 diabetes by *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) code and (1) were dispensed insulin and/or oral hypoglycemics/antihypoglycemics during the measurement year (pharmacy or claims/encounters), or (2) had a diagnosis of diabetes recorded in 2 face-to-face encounters with different dates of service in an ambulatory setting or nonacute inpatient setting or 1 face-to-face encounter in an acute inpatient or emergency room setting during the measurement year (claims/encounters). Other inclusion criteria required that patients be between 18 and 75 years of age and seen by the physician at least once between 2003 and 2005. We excluded those who had gestational diabetes and type 1 diabetes.

Participating physicians were asked to randomly sample their diabetes patients' charts to measure their compliance with the Diabetes Quality Improvement Project performance measures that were developed jointly by the American Diabetes Association, Foundation for Accountability, Centers for Medicare and Medicaid Services, National Committee for Quality Assurance, American Academy of Family Physicians, American College of Physicians (ACP), and the Veterans Administration. These measures make the best use of the available evidence for assessing care or outcomes of care in systems in which compliance, test reliability, and patient characteristics have the potential to influence both treatment and outcome (Table 1).

Table 1

Diabetes Quality Improvement Project Performance Measures

Accountability indicators
HbA1c tested (annually)
Poor HbA1c control (HbA1c ≥ 9.5%)
Eye exam performed (high risk, annually; low risk, biennially)
Lipid profile performed (biennially)
Monitoring for diabetic neuropathy (high risk, annually; low risk, biennially)
Blood pressure controlled (<140/90 mm Hg)
Foot exam (annually)
Smoking cessation (annually)
Quality improvement indicators
Distribution of HbA1c values
Distribution of LDL cholesterol values
Distribution of blood pressure values
Diabetes self-management and nutrition education
Interpersonal care

Abbreviations: HbA1c, glycated hemoglobin; LDL, low-density lipoprotein.

The Intervention

The Web-based educational module, composed of 13 chapters, was distributed to participating physicians after the baseline data abstraction. The decision to use the Internet for the module was made because of its interactive nature and ability to be updated easily when new evidence becomes available. The module was enhanced with practice tools and patient education resources with chapters on diagnosis, weight loss, BP, smoking cessation, glycemic control, lipids, dilated eye examination, screening for microalbumin, foot examination, vaccinations, diabetes education, and exercise programs. Each chapter included information, a review quiz, and a bibliography with journal references for that section. Practice tools and self-assessment also were included in the module. Practice tools included enabling tools and patient education. At the end of the module, there was a comprehensive self-assessment section complete with case studies. All materials were excerpted from MKSAP 12, an ACP clinical education product used to assess and improve clinicians' medical knowledge.

Evaluating the Impact of the Intervention/Data Collection

Baseline and follow-up data were sent to ACPNet staff for data entry and analysis. A total of 1172 randomized patient charts were abstracted over the course of the study. The study design included the quality improvement component of physicians performing the baseline data abstraction, which required them to actively read through their own charts and review their own management of patients with diabetes.

Data were derived by randomly selecting 25 patients and performing chart audits using data abstraction sheets. Data were analyzed using descriptive analysis to compare individual physicians with the aggregate to evaluate the quality of care. Each practice that submitted data received a detailed report on their performance comparing individuals to group aggregate data. Data reports were used by the physicians to develop quality

improvement plans that targeted various measures such as reduction in low-density lipoprotein (LDL), BP, and glycated hemoglobin (HbA1c) levels as well as improving the rate of eye and foot exams for their patients with diabetes.

Because of the nature of the outcomes measured (eg, eye and foot exams, lab test scheduling), it was thought that a longer time frame would compensate for any delays (eg, rescheduling/waiting for appointments) and provide the most accurate record of the outcome measures data. Additionally, a final feedback report was sent to study physicians comparing the quality of the care given over the course of the project at all 3 points of data abstraction.

RESULTS

Aggregated demographic and clinical information are reported in Tables 2 and 3. Descriptive statistics of the study participants' patient population showed that the majority of patients were male (51.2%), older than 60 (67.2%), had a BMI ≥ 30 (60.8%), and were diagnosed with type 2 diabetes (87.4%; Table 2).

We aggregated accountability and quality indicator measures from May 2003 to May 2005 and compared these results. Frequency analysis was performed, analyzing means and percentages. Aggregate baseline and follow-up data were analyzed by phase.

The rate of documented foot exams performed within 1 year increased from 51.5% at baseline to 83.0% by phase 3. The rate of documented eye exams increased from 34.7% at baseline to 58.1% by phase 3. The percentage of patients receiving influenza vaccine increased from 21.8% at baseline to 58.1% by phase 3. Pneumococcal vaccine rates decreased from 53.9% at baseline to 46.8% by phase 3, which probably was caused by the pneumococcal vaccine shortage in 2004-2005.

The percentage of patients whose BP was controlled (≤140/90 mm Hg) increased from 67.9% at baseline to 79.2% by phase 3. Percentage at HbA1c goal values (<7.0) increased from 51.3% at baseline to 55.8% by phase 3. However, there was a decrease in the number of patients who had a lipid profile performed in the past year, from 100% at baseline to 96.8% by phase 3. The percentage of patients with controlled LDL (<100 mg/dL) increased from 44.0% at baseline to 49.4% by phase 3. Urine protein tests performed in the past year increased from 38.6% at baseline to 55.2% by phase 3. There was a decrease in the percentage of patients at triglyceride goal (<200 mg/dL) from 61.6% at baseline to 58.7% by phase 3. (Refer to Table 3 and Figures 1 and 2 for more information.)

In summary, the results showed an improvement for the following quality measures over the period from May 1, 2003, to May 1, 2005: documented foot exam, documented eye exam, influenza vaccine, BP control, HbA1c control, LDL control, and urine protein testing. The results of this study showed that the use of a Web-based educational intervention improved the quality of care that patients received from the physician participants. The intervention demonstrated a positive

Table 2

Patient Characteristics

	Baseline (n = 427)	Phase 2 (n = 399)	Phase 3 (n = 346)
Sex			
Male*	215	163	171
Female*	212	212	162
Age			
≤35 Years of age†	13	6	9
36-55 Years of age†	70	93	73
≥56 Years of age†	309	298	262
Insurance			
Medicare/Medicaid‡	217	197	156
Privately insured‡	120	178	171
No insurance‡	6	2	7
Years with diagnosis			
0-10 Years with diagnosis§	244	247	223
11-20 Years with diagnosis§	82	76	71
>20 Years with diagnosis§	35	26	23
Race			
American Indian/ Alaskan Native¶	27	27	28
Asian¶	67	84	69
Black¶	55	49	43
White¶	177	163	154
Native Hawaiian¶	35	26	23
Body Mass Index (BMI)			
BMI < 18.5#	1	0	1
BMI 18.5-24.9	29	33	28
BMI 25.0-29.9	91	82	67
BMI ≥ 30.0	148	177	149

*Sex not noted for 24 patients at phase 2 and 13 patients at phase 3.

†Age not noted for 35 patients at baseline, 2 patients at phase 2 and 2 patients at phase 3.

‡Insurance type not noted for 84 patients at baseline, 22 patients at phase 2 and 12 patients at phase 3.

§Years with diagnosis not noted for 66 patients at baseline, 50 patients at phase 2 and 29 patients at phase 3.

¶Race not noted for 66 patients at baseline, 50 patients at phase 2 and 29 patients at phase 3.

#BMI not noted for 158 patients at baseline, 107 patients at phase 2 and 101 patients at phase 3.

Table 3

Performance Measures at a Glance

Measure	Baseline (n = 427)	Phase 2 (n = 399)	Phase 3 (n = 346)
Foot exam within last year	51.52%	71.46%	89.25%
Eye exam within last year	34.66%	55.14%	58.09%
Influenza vaccine within last year	21.80%	47.60%	58.10%
Pneumococcal vaccine within last year	53.90%	43.90%	46.80%
BP 2 times in past year	—*	97.24%	98.55%
BP controlled (140/90 mm Hg)	67.92%	75.19%	79.19%
HbA1c 2+ times in past year	—*	85.71%	77.46%
HbA1c controlled (<7)	51.30%	52.60%	55.80%
Lipid profile performed in past year	100.00%	94.30%	96.80%
LDL controlled (<100 mg/dL)	44.00%	45.90%	49.40%
Urine protein test performed in past year	38.60%	56.10%	55.20%
Triglyceride goal (<200 mg/dL)	61.60%	59.20%	58.70%

Abbreviations: BP, blood pressure; HbA1c, glycated hemoglobin; LDL, low-density lipoprotein.

*These values were lost because of registry system failures.

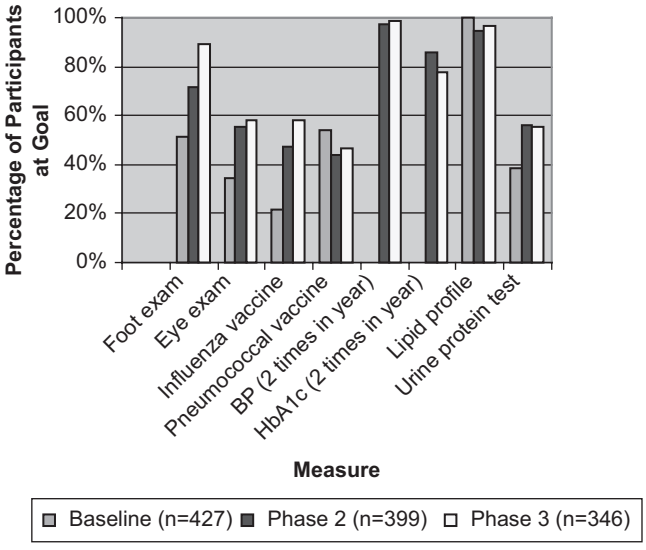

Figure 1. Process measures

Abbreviations: BP, blood pressure; HbA1c, glycated hemoglobin.

sustained change in process and clinical outcomes measures at 24 months post baseline.

DISCUSSION

Our study showed that there was an improvement in process and clinical outcomes for most measures, most notably in foot and eye exams and influenza vaccines. These results support

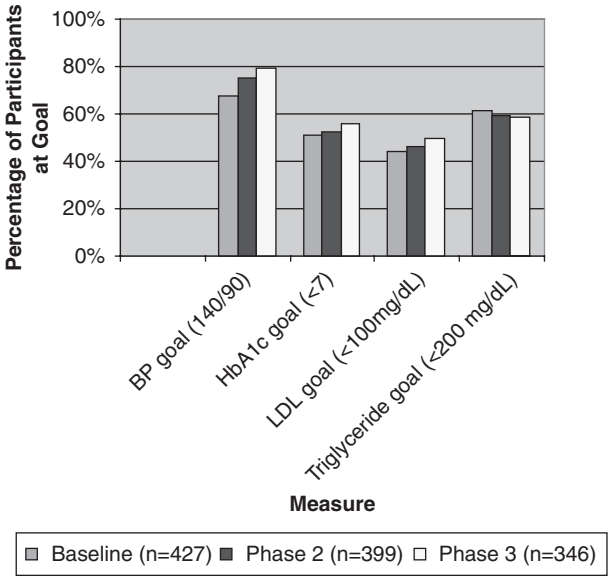

Figure 2. Outcome measures.

Abbreviations: BP, blood pressure; HbA1c, glycated hemoglobin; LDL, low-density lipoprotein

our hypothesis that reinforcing clinical guidelines with (1) an easily accessible online module and (2) feedback reports to act as reminders and benchmarks, coupled with a full commitment from the physician, will all contribute to overall improved clinical care.

We compared aggregate phase 3 data from this study with national data. Compared with the national average for HbA1c testing (90.0%), a higher percentage of diabetes patients in this study received an HbA1c test at least once annually (95.0%). Study participants' patients also demonstrated better controlled HbA1c on average than the national norm. More than half (56.0%) of study participants' diabetes patients had HbA1c values less than 7%, compared with 38.0% of diabetes patients nationwide. Even more dramatic is the proportion of patients who had HbA1c values greater than 9.0%: 10.0% in this study versus 29.0% nationally. About 80% of study participants' diabetes patients had HbA1c values below 8% compared with less than 60.0% nationally. The percentage of study participants' patients who had an LDL score <130 mg/dL (80.1%) was greater than the national average (60.0%). The percentage of study participants' patients who had an LDL score <100 mg/dL (53.2%) was greater than the national average (32.0%).[16] The percentage of study participants' patients who had a foot exam in the past

year (83.0%) was also greater than the national average (66.6%).

Our data indicate that study participants had a higher percentage of obese/extremely obese patients (60.8%) than the national average (46.0%). This is interesting because although there was a higher percentage of obese/extremely obese patients in this study, LDL and HbA1c levels were better than the national average. Typically, there is an association between BMI, LDL, and HbA1c, yet that did not appear to be the case in this study. This may be because of the effective medical care provided by the study participants.[16]

This project was used to generate insight into working with a community of rural physicians to improve clinical management of diabetes by using a Web-based intervention as opposed to traditional CME or print journals. Practice-based research is fundamental to drive the translation of research into practice and is most relevant to the concept of examining small systems to impart changes at a larger level.[17] Previous studies have demonstrated the effectiveness of practice redesign as a valuable tool in effecting change.[18,19] This study aimed to streamline the process and make the intervention electronic in nature, thus easing the burden on the physician's time.

This Web-based educational approach aided physicians in (1) providing a better quality of care to their patients and (2) reinforcing standards of care. The program's success and effective implementation were derived from encouraging the practices to pick achievable goals and enabling them to work toward realizing sustainable practice redesign. An innovative aspect of this project entailed the hands-on approach of teaching physicians evidence-based care to improve clinical practice. By encouraging practices to begin slowly and implement small goals, the project was able to improve sustainability. Next steps may be to more closely examine the work flow processes and identify more efficient ways to capture and aggregate patient data, so that clinicians may demonstrate high-quality patient management and direct efforts and resources to areas in the care system that are suboptimal.

Limitations

Several limitations were associated with this research project. One is the lack of physician demographic data. Physician demographic data are very useful to analyze practice patterns and may help explain varying performances between physicians. Another limitation is the nature of the physicians involved in this research. By electing to participate in a research study, which they partially funded, our study participants proved to be different from the general practicing internal medicine physician. Physicians who are interested in improving the clinical care they provide to patients with diabetes may be more inclined to improve their care over the course of the project, given their research bias. The self-report chart audit is another possible limitation. No professional medical abstraction company was contracted to audit the charts; therefore, the accuracy of the audit is not entirely known and valid. Another concern is generalizability, given that this project only sampled physicians from a Physician Health Organization in 1 geographic site.

Several physicians were unable to submit the full 25 chart abstractions, explaining the change in n value between phases. Another limitation is that 11 of 18 participants used Diabetes Flow Manager, a diabetes database, for the baseline data collection. Because of the Diabetes Flow Manager interface issues, multiple BP and HbA1c measurements were not captured for these participants. For this reason, baseline BP and HbA1c process measures were not aggregated, and the decision was made to ask all participants to submit chart abstraction data via paper-based abstraction sheets. These issues have brought to light some of the challenges physicians face when trying to implement quality improvement processes in their practices and will aid us in defining future research.

Future Direction and Policy Implications

The study physicians have made significant progress in several key quality measures over the duration of the project period. This may be attributable to the reinforcement of diabetes practice guidelines delivered through the online module and/or feedback reports that compare individual physician-level aggregates with group aggregates, or any other formal or informal quality improvement efforts that may have been in place during the project period. Longitudinal tracking of performance demonstrates patient care quality and improvement in concrete, objective terms, which is crucial in the health care climate that is increasingly moving toward pay for performance.

Few people deny that health care quality in the United States is inadequate. This is because of our antiquated, fragmented health care systems and not because of a failure on the part of clinicians. Although the macro-level system is beyond the scope of the current project, we hope that the results of this project can stimulate discussions about ways in which primary care clinicians can incrementally improve their practice systems to increase accuracy and efficiency, and work toward more effective clinical care.

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