Quality Improvement for Diabetes Care

Improving Diabetes Care through a Multi-tiered Quality Improvement Model

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Disclosure of Potential Conflict of Interest
All investigators in the study do hereby disclose that we have no potential conflict and/or competing interest we or our dependents (spouse, dependent children, or others claimed as dependents) may have with any organization with commercial, proprietary, or political interests relevant to the topics covered by this proposal.

Signature form was faxed directly.
ABSTRACT

CONTEXT: We report the results of implementing a diabetes mellitus guideline in a group practice in which uniform technology-generated care processes were produced for patients, clinical staff, and providers. OBJECTIVE: To increase the annual rate of recommended tests and examinations for patients with diabetes and to reduce levels of HgA1c, blood pressure, and LDL cholesterol. INTERVENTION: A process change for type 2 diabetes mellitus was implemented. This included changes in office visit structure; protocol-driven electronic prompts for nursing and physician staffs; clinical decision support built into a new EMR form; and audit with feedback. PARTICIPANTS: 12 primary care physicians treating a total of 1592 patients with diabetes by January, 2008. RESULTS: Prompt and statistically significant improvements in five process measures and 2 outcome measures; 8% overall improvement in a quality summary measure. CONCLUSIONS: Statistically significant improvements with moderate effect size were observed after multi-tiered intervention.
INTRODUCTION

Although advances in diabetes treatment in the last part of the 20th century have resulted in impressive reductions in morbidity and mortality, it is widely recognized that diabetes management by primary care physicians in the US is less than optimal. A variety of tools promote adoption of clinical practice guidelines, including those formulated by the American Diabetes Association. These tools include telephone reminders, flowsheets, computer-based protocols, and continuous quality improvement (CQI) methods based on best practice. However, application of these tools individually to improve diabetes care has produced inconsistent results.

The deficiencies in diabetic care are reflective of the relatively slow progression in quality improvement in the physician office setting. Audet et al. conducted a national physician survey and found that most physicians do not implement formal quality measurement and improvement methods in their practices. In addition, only one third of physician respondents indicated that they participated in office redesign for quality improvement. Though physician offices offer significant opportunities for impacting the cost and quality of healthcare, their diversity in type, size, and organizational structure renders the development of standard approaches to quality improvement difficult.

The Institute of Medicine (IOM) recommends system re-design as the essential first step toward improving chronic disease quality measures. They suggest that “carefully designed evidence-based care processes, supported by automated clinical information and decision support systems, offer the greatest promise of achieving the best outcomes.” However, the IOM makes note of multiple challenges including the need for tools to organize and deliver care, the need for
effective teams, and the need for improved technology to automatically gather, analyze, and present clinical information for patients and team members alike.

We asked the research question: Can a multi-tiered intervention that includes quality improvement and automatic computer-based protocols facilitate positive changes in diabetes care delivery? We performed a case study of diabetes care process change in a community practice under the guidance of a Quality Committee (QC) with Physicians Health Alliance (PHA), a community group practice of primary care physicians in northeast Pennsylvania.

METHODS

The study entailed a quality improvement process in a medium-sized community group practice in which 12 clinicians had been using an electronic medical record (Centricity® Office-GE) for several years. The study took place in 2007. Initial efforts focused on creating and authenticating a diabetes registry and observing the effect of this validating effort on diabetes process measures. Inclusion criteria on the registries were all active patients at least 18 years of age with a diagnosis of diabetes mellitus. An active patient was defined as one having an ICD-9 code on the active problem list identifying the patient as diabetic with a progress note in the EMR associated with an office visit within the prior 12 months. Coding criteria were selected according to standards established by the National Committee for Quality Assurance. In an effort to ensure accuracy of the registries, physicians and their clinical support staff were presented with a report of patients who had a diagnosis of diabetes on the problem list. Patients misidentified on these reports were removed from the diabetes registry.

At the study onset, we sought buy-in from clinicians by demonstrating to the group unacceptable baseline levels of diabetes care and by developing consensus that process change
was urgently needed. Each provider agreed to a goal of achieving the targets set by the National Committee for Quality Assurance (NCQA) for diabetes care within 6 months. The subsequent implementation process included four steps: (1) collection of baseline measures of diabetes care performance; (2) identification and selection of clinical tools that facilitated systematic task completion through visit redesign, EMR prompts, electronic clinical decision support, tailored handouts to encourage patient self-management, and a simplified referral process for diabetic education; (3) a physician education plan; and (4) measurement of the impact with feedback to clinicians.

QC was comprised of representatives of the information technology department, the administration, providers, and clinical staff of PHA. Various tools that altered the diabetic care process were created. We worked as a QC to develop a multi-tiered process change based on local best practice and consensus. Specifically, protocol-based computer prompts directed to nursing staff and clinicians served to redesign the office visit. Nursing staff was requested to document patients’ recent eye exam or to refer them for dilated exam; to collect urine specimens; and to request removal of patient footwear in preparation for provider exam. For patients with poorly controlled hypertension, pop-up dialog boxes prompted clinicians to consider addition of thiazide medication or to navigate to the patient’s medication list. Paper-based prompts suggested diabetes education referral when appropriate. Glycemic control and lipid management support were provided through color-coded conditional formatting of patient data on a newly created “Diabetic Excellence Protocols” form (Figure 1). This form, designed to load automatically at the start of each visit, included single mouse-click ‘action buttons’ for easy printing of medication lists, diabetes education topics, and consultation requests for diabetes educators. Diabetes self-management education was integrated into the process by three
methods. First, a diabetic handout with tailored patient-specific information and
recommendations printed automatically at visit outset when lab data was current. This handout
provided clinicians an opportunity to highlight areas of shared concern. Second, clinicians were
prompted to refer for formal diabetes education when documentation of such education was
lacking. Furthermore, the referral process itself was streamlined so that a single click on the
Diabetic Excellence Protocols form printed a referral sheet that was faxed to diabetes educators.
Finally, action buttons on this form allowed immediate printing of handouts on a variety of self-
management topics. This allowed clinicians to provide written material to patients reinforcing
messages delivered during the visit.

The study indicators, listed in Table 1, were based on recommendations of the American
Diabetes Association\(^3\) and others.\(^{15,16}\) Eight indicators were process measures, reflecting
whether recommended tests were performed. Four were outcome measures, reflecting whether
patients achieved recommended treatment goals. A summary measure termed the diabetes
summary index was calculated as the mean of the 12 measures. For the primary analyses (Table
3), we calculated practice-level performance for each measure at baseline and follow-up and
compared changes by paired \(t\) tests.

Each month beginning in March, 2007, the authors sent practice level reports of study
indicators\(^7\) to all practices. SAS-Enterprise Guide 4.1 (SAS-EG) was utilized to extract patient
activity during the previous month. To protect patient confidentiality, the research was
performed using only the unique, anonymous numerical identifier for each patient. SAS-EG
extracted demographic information such as age, race, gender, diagnoses, medication, laboratory
data, and vital signs. The text of progress notes, consultation reports, and discharge summaries
was not extracted. Provider reports used conditional formatting to illustrate for each clinician his/her performance in comparison to the anonymous data of other individual clinicians.

**Educational Process**

In June, 2007, clinicians were provided with educational material and asked to complete a self-study course developed by American College of Physicians. In early July, 2007 implementation meetings were held. All clinicians attended one of the meetings. Two major activities occurred at these meetings. The first activity was demonstration of the redesigned diabetes visit as envisioned by Quality Committee. The second activity was demonstration of the technique of motivational interviewing delivered by a local expert in this technique.

**Measurements**

Major outcomes used in the analyses were expressed at the practice level. For each practice, 12 proportions were calculated that corresponded to the 12 study indicators (Table 1). For each study indicator, the proportion corresponded to the percentage of diabetes patients in that practice who had met that study indicator’s target. In addition to the 12 specific study indicator outcomes, a summary measure was constructed for each practice. This summary measure, which we termed the diabetes summary index, reflected the average percentage of the 12 targets met by patients in that practice.

Six clinics comprised of 12 physicians were included in the analyses. Two were family medicine physicians, and 10 were internal medicine physicians. These practices had 24,650 active patients at least 18 years of age on January 1, 2007, 1250 (5.0%) of whom had a diagnosis of diabetes mellitus. On January 1, 2008, they had 24,895 active patients at least 18 years of age,
1592 (6.5%) of whom had a diagnosis of diabetes mellitus. The average age of the diabetes patients on January 1, 2007 was 67.7 years (SD = 13.9), and 46.8% of were male.

RESULTS

At project outset, initial queries on the patients’ problem lists revealed that 869 of 1951 ‘diabetic’ patients were not taking diabetes medications. Although 327 of the patients not on diabetes medications were considered by the primary physician as ‘diet stage’ diabetics, 532 were found to have been misidentified. The problem was dated from the purchase of the group’s EMR system. Early versions of the software allowed use of a ‘Family Hx’ modifier using ICD-250.* instead of the correct V18.0 code. We calculated the ‘improvement’ of process measures which could be noted merely by correcting this particular inaccuracy in the diabetes registry (Table 2).

Changes in Performance of Study Indicators

The average diabetes summary score was 61.2% on January 1, 2007 (10th percentile 50.1%, 90th percentile 70.0%). On January 1, 2008, the average diabetes summary score was 70.1% (10th percentile 61.6%, 90th percentile 78.1%). The 12-month improvement in the mean diabetes summary score was 8.87% [95% confidence intervals (CI), 4.9%, 12.9%]. Statistically significant improvement occurred for 5 of 8 process measures and for 2 outcome measures (see Table 5). One outcome showed a trend toward improvement. All other outcomes showed insignificant improvement. Ranked by effect size, the greatest statistically significant improvements (more than 10%) occurred in documentation of foot exams and urinary microalbumin.
DISCUSSION

Tai\textsuperscript{18} noted the importance of assuring an accurate database prior to initiating data collection in CQI efforts. Our data supports his findings. Registry clean-up is a vital first step that must occur prior to baseline data collection.

The findings presented in this report suggest that community group practices utilizing EMRs that are customizable and reportable may be able to successfully employ quality improvement methods, built-in protocols, and advanced clinical decision support to redesign health care processes. Furthermore, when these methods are used in the setting of shared goals, very rapid rates of improvement of quality measures may result. Previously published interventions\textsuperscript{19,20} have required 18 months at the minimum, and as long as 5 years generally, to demonstrate as much as an 8\% overall improvement in quality measures. Our intervention yielded a similar level of improvement in 12 months. The improvements occurred across a spectrum of indicators. Performance improved for practices performing at a range of levels at baseline, and there were comparable increases in the mean, 10th percentile, and 90th percentile measure of the diabetes summary index.

The foundation of our process redesign was an electronic form that loaded automatically at the start of each visit. Schnipper\textsuperscript{21} has noted that electronic forms as a part of clinical decision support systems have had limited effectiveness for a variety of reasons including lack of integration into workflow, software usability issues, and relevance of the content to the patient at hand. Our form was carefully designed by the PHA Centricity project manager who had special expertise in form development working in concert with a physician-programmer. The result was
a fully integrated form with robust clinical decision support. The staff has reported no issues with form usability.

A prominent feature of our intervention was provider-level reports allowing anonymous peer comparison. Unlike manual chart audits, the reports provided in this project were highly automated, involving a few minutes of practice staff time each month. Tangible benefits in our case included recognition status on the NCQA website. As practice-level implementation progressed and audit-feedback occurred, most practices found that the effort required an increased frequency of visits for patients with diabetes, enabling more consistent monitoring of the applicable indicators.

We found that robust improvement in quality measures can occur in very short time periods when clinicians are motivated by a common goal, when quality is built into the encounter, and when regular audit and feedback are provided.

There are three important limitations of the present report. First, there was no comparison group, and it is not possible to be certain that the improvements noted among the 12 practices were due to the study interventions and not merely to changes which would have occurred independently without the process change. Although diabetes care continues to improve in the US,22 the magnitude of the observed benefits makes it unlikely that the improvement in this study was entirely due to external factors. The 2005 National Healthcare Quality Report (NHQR) documented a median 1-year improvement of only 2.8% in overall care quality, approximately one third of the annualized improvement in our diabetes summary index.22 Also, it is impossible to ascertain whether the increased motivation due to shared goal setting or external factors was most responsible for the improvements noted. Second, our results may not be generalizable to the majority of physician practices in the US. Our group was fortunate to
have implemented a fully-functional EMR in 2001. DesRoches\textsuperscript{23} notes that only 4\% of US practices have such an extensive fully functional electronic record systems capable of providing “reminders regarding guideline-based interventions.” Our group’s well-developed local programming expertise allowed PHA to develop an Excellence in Diabetes Care form that automatically presented to clinicians such reminders ‘en bloc’ for each diabetic at visit start. A third limitation is that the indicators included in this study reflect only a subset of guidelines for management of diabetes care. Other important indicators, such as provision of antiplatelet therapy, recommended immunizations, and nutrition/physical activity counseling were not assessed.

**CONCLUSION**

It is likely that the performance of practices in this study is much better than national averages. The 2005 NHQR indicated that among patients with diabetes, 70.9\% have blood pressure values less than 140/90 mm Hg.\textsuperscript{22} In our study, 72\% of patients had blood pressure values less than 140/80 mm Hg at study start, and 76\% at completion of the study. Similarly, the NHQR reported performance of foot exam in 72\% of patients with diabetes in contrast with the 85\% in our study, and that glycosylated hemoglobin was less than 7\% in 39.8\% of patients with diabetes, whereas our practices achieved this target in 50\% of patients. These findings suggest that quality improvement programs for practices which have good EMR capacity can allow care process redesign among primary care practices to improve the delivery of medical care.
REFERENCES


national cholesterol education program (NCEP) expert panel on detection, evaluation, and
treatment of high blood cholesterol in adults (adult treatment panel III) final report. *Circulation.*


Table 1. Study Indicators

<table>
<thead>
<tr>
<th>Process measures</th>
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</thead>
<tbody>
<tr>
<td>Measurement of hemoglobin A1c in prior 6 months</td>
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<tr>
<td>Measurement of blood pressure in prior 6 months</td>
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<tr>
<td>Measurement of LDL cholesterol in prior 12 months</td>
</tr>
<tr>
<td>Measurement of HDL cholesterol in prior 12 months</td>
</tr>
<tr>
<td>Measurement of triglycerides in prior 12 months</td>
</tr>
<tr>
<td>Measurement of urinary microalbumin in prior 12 months</td>
</tr>
<tr>
<td>Performance of dilated eye exam in prior 12 months</td>
</tr>
<tr>
<td>Performance of foot exam in prior 12 months</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most recent hemoglobin A1c &lt;7%</td>
</tr>
<tr>
<td>Most recent BP measurement &lt;130/80 mm Hg</td>
</tr>
<tr>
<td>Most recent LDL cholesterol &lt;100 mg/dL</td>
</tr>
<tr>
<td>Most recent HDL cholesterol &gt;45 mg/dL</td>
</tr>
</tbody>
</table>

LDL = low-density lipoprotein; HDL = high-density lipoprotein; BP = blood pressure.
Table 2. Comparison of Process Indicators obtained from queries of ‘raw’ data without correction of inaccurate diabetes diagnosis vs. ‘cleaned’ data from accurate diabetes registry, January 2007.

<table>
<thead>
<tr>
<th>% of Patients at Targets Among 12 Practices</th>
<th>Mean of Raw Data (n=1882)</th>
<th>Mean of Accurate Data (n=1250)</th>
<th>Difference</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>HgA1c in last 6 months</td>
<td>59.1</td>
<td>63.7</td>
<td>4.6</td>
<td>0.003</td>
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<td>Blood pressure in prior 6 mo</td>
<td>92.3</td>
<td>92.4</td>
<td>0.0</td>
<td>0.9</td>
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<tr>
<td>LDL cholesterol in prior 12 mo</td>
<td>85.2</td>
<td>86.1</td>
<td>0.8</td>
<td>0.2</td>
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<tr>
<td>HDL cholesterol in prior 12 mo</td>
<td>81.6</td>
<td>83.1</td>
<td>1.5</td>
<td>0.05</td>
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<tr>
<td>Triglycerides in prior 12 mo</td>
<td>84.6</td>
<td>85.5</td>
<td>0.9</td>
<td>0.2</td>
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<tr>
<td>Urinary microalbumin in prior 12 mo</td>
<td>41.1</td>
<td>45.6</td>
<td>4.5</td>
<td>0.001</td>
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<td>Dilated eye exam in prior 12 mo</td>
<td>39.7</td>
<td>43.3</td>
<td>3.6</td>
<td>0.003</td>
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<tr>
<td>Foot exam in prior 12 mo</td>
<td>46.3</td>
<td>50.8</td>
<td>4.6</td>
<td>0.007</td>
</tr>
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</table>

*P values are based on paired t tests.
Table 3. Performance for Study Indicators at Baseline (January 1, 2007) and Follow-Up (January 1, 2008)

<table>
<thead>
<tr>
<th>Process Measures</th>
<th>10th Percentile</th>
<th>Mean</th>
<th>90th Percentile</th>
<th>10th Percentile</th>
<th>Mean</th>
<th>90th Percentile</th>
<th>Mean Change</th>
<th>SD</th>
<th>95% Confidence Interval</th>
<th>P value*</th>
</tr>
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<tbody>
<tr>
<td>HgA1c in last 6 months</td>
<td>49.2</td>
<td>63.7</td>
<td>75.2</td>
<td>63.4</td>
<td>73.8</td>
<td>87.1</td>
<td>10.1</td>
<td>4.4</td>
<td>7.4, 12.9</td>
<td>&lt;0.001</td>
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<td>Blood pressure in prior 6 mo</td>
<td>86.3</td>
<td>92.4</td>
<td>97.2</td>
<td>90.3</td>
<td>94.2</td>
<td>97.0</td>
<td>1.9</td>
<td>4.1</td>
<td>-0.7, 4.4</td>
<td>0.1</td>
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<tr>
<td>LDL cholesterol in prior 12 mo</td>
<td>76.4</td>
<td>86.1</td>
<td>92.1</td>
<td>80.3</td>
<td>88.9</td>
<td>95.7</td>
<td>2.8</td>
<td>5.6</td>
<td>-0.7, 6.3</td>
<td>0.1</td>
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<td>HDL cholesterol in prior 12 mo</td>
<td>72.5</td>
<td>83.1</td>
<td>90.9</td>
<td>76.5</td>
<td>86.6</td>
<td>93.3</td>
<td>3.5</td>
<td>6.0</td>
<td>-0.3, 7.4</td>
<td>0.033</td>
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<tr>
<td>Triglycerides in prior 12 mo</td>
<td>74.2</td>
<td>85.5</td>
<td>92.1</td>
<td>80.3</td>
<td>89.0</td>
<td>96.0</td>
<td>3.5</td>
<td>6.7</td>
<td>-0.8, 7.8</td>
<td>0.1</td>
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<td>Urinary microalbumin in prior 12 mo</td>
<td>16.3</td>
<td>45.6</td>
<td>72.2</td>
<td>53.0</td>
<td>66.8</td>
<td>90.7</td>
<td>21.2</td>
<td>21.4</td>
<td>7.6, 34.8</td>
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<td>Dilated eye exam in prior 12 mo</td>
<td>13.0</td>
<td>43.3</td>
<td>71.8</td>
<td>20.9</td>
<td>55.8</td>
<td>81.4</td>
<td>12.5</td>
<td>18.5</td>
<td>0.7, 24.2</td>
<td>0.04</td>
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<td>Foot exam in prior 12 mo</td>
<td>12.5</td>
<td>50.8</td>
<td>86.8</td>
<td>67.6</td>
<td>85.4</td>
<td>98.0</td>
<td>34.6</td>
<td>26.7</td>
<td>17.6, 51.6</td>
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<td>Outcome measures</td>
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<td></td>
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<td></td>
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<tr>
<td>Most recent glycosylated hemoglobin &lt;7%</td>
<td>37.3</td>
<td>46.7</td>
<td>53.6</td>
<td>34.6</td>
<td>49.6</td>
<td>59.3</td>
<td>3.0</td>
<td>7.0</td>
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<td>0.08</td>
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<td>Most recent BP measurement &lt;130/80 mm Hg</td>
<td>24.2</td>
<td>40.9</td>
<td>52.1</td>
<td>34.7</td>
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<td>3.6, 13.3</td>
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<tr>
<td>Most recent LDL cholesterol &lt;100 mg/dL</td>
<td>51.0</td>
<td>61.3</td>
<td>76.3</td>
<td>53.2</td>
<td>65.2</td>
<td>74.6</td>
<td>3.9</td>
<td>6.7</td>
<td>-0.4, 8.1</td>
<td>0.036</td>
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<tr>
<td>Most recent HDL cholesterol at target†</td>
<td>26.9</td>
<td>35.6</td>
<td>39.8</td>
<td>30.3</td>
<td>36.8</td>
<td>45.3</td>
<td>1.1</td>
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<td>-3.0, 5.3</td>
<td>0.55</td>
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<tr>
<td>Diabetes Summary Index</td>
<td>50.1</td>
<td>61.2</td>
<td>70.0</td>
<td>61.6</td>
<td>70.1</td>
<td>78.1</td>
<td>8.87</td>
<td>6.3</td>
<td>4.9, 12.9</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

LDL = low-density lipoprotein; HDL = high-density lipoprotein; BP = blood pressure.
*P values are based on paired t tests.
† HDL target >= 40 for males; 50 for females.
**LEGEND FOR FIGURE**

Figure 1. Screen shot of PHA Diabetic Excellence Protocol form
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