Quality Improvement and Changes in Diabetic Patient Outcomes in an Academic Nurse Practitioner Primary Care Practice

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INTRODUCTION

Transferring research knowledge into practice habits to achieve positive clinical outcomes is an aspiration of many clinicians. Unfortunately, many promising research findings are never implemented in the clinical setting. There is no simple fix for this problem. Rather, improvements in patient outcomes in primary care are a result of system change. “At the health system level there is growing evidence that improvements in 6 interrelated components of primary care for patients with chronic illnesses—clinical information systems, delivery system redesign, decision support, healthcare organization, patient self-management support, and community resources—can significantly improve clinical processes and outcomes” (Heisler & Wagner, 2004, p. 115). The delivery of quality care is as much a system issue as it is a provider issue.

Nurse practitioners (NPs) are in a unique position to influence these six components of primary care outlined by Heisler and Wagner. The purpose of this quality improvement project was to transfer previous research knowledge about system change into action and then evaluate the results of those actions applied to the care of patients with diabetes. Further, it is an attempt to demonstrate how utilization of research findings in the clinical setting can positively impact processes and outcomes for patients with diabetes.

BACKGROUND

The University of Texas Health Services (UTHS) is an NP-managed clinic that started in 1991. UTHS delivers primary and occupational health services to some 12,000 patients yearly. UTHS is staffed with two family NPs, 0.20 full-time equivalent (FTE) physicians, two receptionists, one licensed vocational nurse (LVN), and one medical assistant. Other registered nurses deliver off-site occupational health services but were not involved with this study. All patients are either insured through a third party (indemnity or managed care insurance coverage) or covered through their employer for the occupational health care they receive. Patients in this study were all enrolled in some type of insurance plan.

In 1994, UTHS installed an electronic medical record (EMR) consisting of patient records, billing and appointment making called Practice Partner from Physician Micro Systems, Inc. in Seattle, Washington. To date, UTHS has over 150,000 patient encounters in this system. In 1998, UTHS joined Practice Partner Research Network (PPRNet), which is a group of primary care practices from around the country that use Practice Partner software and have organized to collect data for research purposes. In 2000, the Agency for Healthcare Research and Quality funded PPRNet to evaluate the
multiple strategies previously validated in efficacy studies, which were intended to help accelerate the impact of health services research on direct patient care. During the study, “practices experimented with new approaches to practice operations and care delivery. [They] documented the activities and structures that emerged in each practice as part of the trial’s process evaluation. One aim of this evaluation was to develop a model of improvement strategies that might serve as an example for others” (Feifer & Ornstein, 2004, p. 433).

In July 2003, the findings of that study were presented at the PPRNet annual meeting, and the UTHS director decided to implement those findings at the UTHS clinic in an attempt to validate their usefulness in the UTHS practice. The PPRNet model consists of five categories of improvement strategies.

- Prioritize performance: accept guidelines such as those of the American Diabetes Association, establish a project leader, get staff buy-in, utilize the PPRNet reports to guide practice improvement, motivate staff for practice improvement
- Involve all staff: train the staff on guidelines and project objectives, address project at staff meetings, empower staff to perform improvement processes, encourage staff collaboration for the processes, clearly delineate responsi-

product mentioned in this article that might represent a conflict of interest. No inducements have been made by any commercial entity to submit the manuscript for publication.

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**LITERATURE SEARCH**

Many studies have reported the suboptimal care processes for patients with diabetes and subsequent poor outcomes (Harris, 2000; Saadidine, Engelgau, Beckles, Thompson, & Narayan, 2002; Saydash, Fradkin, & Cowie, 2004). In a recent study of primary care practices in 12 urban areas, patients with chronic conditions (diabetes included) received less than 60% of recommended care for their conditions (McGlynn et al., 2003). Fuke et al. (2004) found a high prevalence of inadequate lipid control among patients with diabetes, with and without coronary artery disease, in a primary care practice-based research network. Surprisingly, they found that only 20% of patients with diabetes received a prescription for any lipid-lowering treatment.

At the health systems level, there is growing evidence that improvements in six interrelated components of primary care for patients with chronic illnesses—clinical information systems, delivery system redesign, decision support, healthcare organization, patient self-management support, and community resources—can significantly improve clinical processes and outcomes (Heisler & Wagner, 2004). Heisler and Wagner (2004, p. 115) believe there “are no simple fixes to improving the quality of diabetes care. Rather, improved outcomes follow integrated system changes involving more concerted leadership, clinical information system enhancements, better coordination and follow-up, more consistent and collaborative self-management support, and attention to comorbid conditions.”
The effects of a collaborative case management intervention were evaluated by Krein et al. (2004) for patients with poorly controlled type 2 diabetes related to glycemic control, intermediate cardiovascular outcomes, satisfaction with care, and resource utilization. Two NP case managers worked with patients and their primary care providers, monitoring and coordinating care for the intervention group for 18 months through the use of telephone contacts, collaborative goal setting, and treatment algorithms. At the conclusion of the study, both case management and control patients remained under poor glycemic control and there was little difference between groups in mean exit HbA1C level (9.3% vs 9.2%; difference = 0.1%; 95% confidence interval: −0.4% to 0.7%; p = 0.65). There was also no evidence that the intervention resulted in improvements in low-density lipoprotein (LDL) cholesterol level or blood pressure control or greater intensification in medication therapy.

However, another case management study showed differing results. Taylor et al. (2003) evaluated a case management intervention designed to improve medical, psychosocial, and lifestyle outcomes in people with complicated diabetes. At 1 year, those in the intervention group had significantly reduced HbA1C, total cholesterol, and LDL cholesterol. There was no significant difference in doctor visits, or in any of the self-care or psychosocial variables. While the systems in both of these case management intervention studies were not completely changed, the approach to the patients was changed.

de Fine, Beck-Nielsen, Andreasen, Horder, and Pedersen (2001) assessed whether improving 474 general practitioners’ care using a structured personal care program improved mortality, morbidity, and complication risk factors for people with type 2 diabetes. They provided a personalized structured care program with continuing medical education of general practitioners, providing feedback on patient progress and clinical guidelines aimed at improving outcome measures. Follow-up occurred every 3 months, with yearly screening for diabetes complications targeting glycemic control, diastolic blood pressure, and lipid concentrations. The intervention lasted 6 years. Results showed that there were no differences in outcomes between the structured personal care and the usual care group. Risk factor profiles did differ slightly between groups. HbA1C was 8.5% for the structured care group compared to 9% for the usual care group (p < 0.0001). The average systolic blood pressure was 145 mmHg for structured care versus 150 mmHg for usual care (p = 0.0004).

Whittenore, Bak, Melkus, and Grey (2003) looked at promoting lifestyle change in the prevention and management of type 2 diabetes. “Participation in a program targeting diet and exercise lifestyle change resulted in a 59% reduction in type 2 diabetes development and was better than prevention through a pharmacological approach (i.e., metformin)” (Whittenore et al., 2003, p. 341). Whittenore et al. did not separate out the two (diet versus exercise) and recommended a multimodal approach in translating theories and strategies into clinical practice as no single theory could account for all the relevant factors likely to influence behavior of study subjects.

As noted, these studies provided us with models on which to design the methods for our study.

METHODS

The methods for this project were initiation of system changes designed after the PPRNet model, which consisted of prioritizing our performance based on a self-evaluation, involving all the staff in the process of change and care of our patients with diabetes redesigning our delivery system, activating patients to become more involved in the process of their own care, and finally using the EMR tools at our disposal.

Prioritizing Our Performance

After the July 2003 PPRNet annual meeting, we immediately began to examine the process and outcomes of care for our patients with diabetes. First, we had a series of staff meetings in which we determined that the most glaring process deficiencies included:

- Not all labs were being electronically downloaded into the EMR. Rather, some labs, depending on the lab performing the test, were being sent to UTHS via paper and placed in the paper chart of the patient.
- The EMR had no flow sheets for patients with diabetes, which would allow for simple tracking to determine if the standards of care were being followed for each patient.
- All care for patients with diabetes was NP/MD driven. Other staff (receptionists, LVNs, medical assistants) seldom, if ever, initiated care for patients. For example, LVNs did not offer pneumovax vaccines or take it upon themselves to draw labs unless an order originated from the NP/MD.
- Care templates for the patients with diabetes were not updated. We were using the same EMR templates originally given to us back in 1994 when we installed the system.
- Diabetes received no particular emphasis over other illnesses in our practice. While we felt we took good care of our patients with diabetes, we made no special efforts to improve or change the care we were giving to them.
- Each NP/MD did his/her “own thing” when it came to providing and recording care. There was no systematic way to deliver (what we did) or record (terminology, flow sheets) the care.
- All the NPs/MDs did not fully understand the national guidelines for care of patients with diabetes.

Second, we performed a chart audit that revealed our outcomes (see Table 1) were not what we believed them to be. While our actual outcomes may have been better than our actual audit findings, we have no way of knowing because of the process deficiencies listed above. For example, it was difficult in some charts to discern when the last HbA1C was
performed or even if an ophthalmology referral was done. In these instances, our outcome scores suffered.

**Involve All Staff**

The UTHS director took the leadership role in moving the project forward. The first step was to meet with the entire staff to

- Obtain buy-in from them so as to enlist their support
- Motivate them to improve the care we delivered
- Establish leadership for the project
- Discuss, design, and plan interventions.

We decided that interventions needed to affect the systems we had in place in the office and all of the staff (albeit a small staff), and contain an educational component for both the staff and patients. Our interventions necessarily needed to include all staff to utilize their expertise to reevaluate the organization and assume new roles as the program evolved. New responsibilities were facilitated with guidelines from the director as well as formal training and weekly staff meetings to reinforce the proposed and ongoing changes. Individual staff contributed in the following ways.

**LVN/Med Tech**

- Sent to the diabetes education classes at a local hospital in December 2003
- Empowered to perform labs (blood sugars, HbA1C, urinalysis), give immunizations (Td, pneumovax, flu), reschedule, and teach according to clinical guidelines
- Establish “quick text” templates to be used in charting on patients with diabetes
- Use consistent terminology (i.e., diabetes instead of DM, diabetes mellitus) in all patient records for the sake of uniformity and data-gathering accuracy
- Ordered and distributed glucometers for every patient with diabetes
- Set up policies and procedures for themselves to meet clinical guidelines.

**Receptionists**

- Sent to classes in December 2003
- Assumed responsibility for making return appointments for patients before they left clinic
- Assumed responsibility to double check if appropriate and timely referrals were made (i.e., yearly ophthalmology visits, colonoscopy)
- Filled out reminder postcards for return visits
- Telephoned patients who missed appointments
- Flagged patient charts so as to make charts of those with diabetes obvious to all providers.

**Systems Analyst**

- Hired a new systems administrator in April 2004 to implement multiple changes to our EMR to facilitate recording of data
- Established flow sheets for all patients with diabetes
- Facilitated electronic lab downloads from our contracted lab companies
- Integrated body mass index (BMI), labs, health education, immunizations, within the record
- Provided patient inquiries (i.e., lists of patients with diabetes) to the staff for the purposes of patient education mailings.

### Table 1. Comparison of Pre- and Postintervention Patient Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Preintervention Data</th>
<th>Postintervention Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>M</td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>106–150</td>
<td>125.8</td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td>64–102</td>
<td>81.0</td>
</tr>
<tr>
<td>Weight (pounds)</td>
<td>139–282</td>
<td>211.3</td>
</tr>
<tr>
<td>BMI</td>
<td>21–45</td>
<td>33.1</td>
</tr>
<tr>
<td>Triglyceride (mg/dl)</td>
<td>58–621</td>
<td>216.8</td>
</tr>
<tr>
<td>Cholesterol (mg/dl)</td>
<td>79–265</td>
<td>195.2</td>
</tr>
<tr>
<td>HDL (mg/dl)</td>
<td>17–71</td>
<td>47.8</td>
</tr>
<tr>
<td>LDL (mg/dl)</td>
<td>19–400</td>
<td>122.9</td>
</tr>
<tr>
<td>Glucose (mg/dl)</td>
<td>62–510</td>
<td>156.0</td>
</tr>
<tr>
<td>HbA1c (%)</td>
<td>5–13</td>
<td>7.7</td>
</tr>
</tbody>
</table>

DBP, diastolic blood pressure; SBP, systolic blood pressure.
NPs and MDs

- Attended diabetes diet education classes at the local hospital
- Agreed upon common terminology (i.e., diabetes instead of diabetes mellitus [DM] type I, II)
- Designed and agreed to use flow sheets
- Designed and agreed upon new diabetes templates
- Adopted PPRNet standards of care
- Audited all charts of patients with diabetes for quality of care.

Redesign the Delivery System

Our general practice interventions included

- Site visit from PPRNet to facilitate the process changes mentioned herein
- Letter was sent to all patients with diabetes with information on standards of care and what to expect from UTHS providers
- Adopted PPRNet guidelines
- Project was a topic at each weekly staff meeting
- Enlisted help of pharmaceutical companies for patient educational materials
- Obtained glucometers free from Bayer Corporation for distribution to patients needing them (i.e., those who could not afford them)
- Collected baseline data on all patients with diabetes
- Ostensibly marked the charts of patients with diabetes so that they stood out to providers
- Developed quick text, new templates, and flow sheets for our EMR.

Activate Patients

Essential to this process was involvement of the patients. To this end, we made the following interventions.

- Sent letters to all patients with diabetes outlining our standards of care and asked them to make sure that we cared for them according to those standards
- Requested that at each visit they remove their shoes, without being asked, to make sure we examined their feet.

EMR System

UTHS purchased an EMR system in 1995 that consists of three integrated modules: medical records, billing, and appointment making. Unfortunately, we have not made maximum use of the EMR because of knowledge deficits of its capabilities and operations. Thus, we made the following changes/interventions.

- Hired a new part-time systems administrator
- Hired a software consultant to assist with EMR implementation of new templates, flow sheets, quick tests, and general integration of information specifically related to our patients with diabetes
- Required all practitioners to adhere to standard language and recording procedures.

RESULTS

A query of the EMR system used at the project site for the time period of September 1, 2002, through August 31, 2003 (preintervention period), revealed 92 patients with the diagnosis of DM or hyperglycemia. Only 44 of these medical records were actually usable for this study. Preintervention data were collected from these 44 records and hand recorded on a form. The time period of June 1, 2004, through December 31, 2004, was considered the postintervention period. Of the original 44 usable medical records, only 26 (59%) had data available for the postintervention period. The remaining 18 medical records contained no entries indicating that the patients neither sought nor were provided care during the 6-month postintervention period.

The goal of this project was to examine whether the implementation of a set of interventions could change patient outcomes and provider processes of care. The standards used for this study were the practice guidelines from PPRNet (http://www.musc.edu/PPRNet/guidelines.htm) and the Joslin Clinic (https://diabetesmanagement.joslin.org/Guidelines/AdultClinGuide.pdf). As shown in Table 1, the only statistically significant patient outcome change using Wilcoxon matched-pairs signed-ranks test ($Z = −2.51, p = 0.01$) was found in LDL scores with the mean LDL of 122.0 mg/dL in the preintervention period and 97.9 mg/dL in the postintervention period.

The project team was also concerned if the care being provided met the standards of care for a patient with DM. As shown in Table 2, the healthcare team made great strides in assuring that patients were being provided care consistent with these standards of care. All process of care parameters were improved with the greatest gains made in vaccinating patients with pneumococcal vaccine (95% change from pre- to post-study), flu vaccination (73% change), and aspirin therapy (57% change). Other processes that significantly improved were education related to exercise, alcohol usage, and smoking cessation (35%, 34%, and 30%, respectively). Statin therapy and placement on angiotensin-converting enzyme (ACE) medications showed a 27% and 20% increase from pre- to post-study.

DISCUSSION

The small sample size coupled with the unique aspects of this clinic (e.g., revenue generating clinic that provides care to insured individuals as well as maintains contracts for medical services with area businesses) limit the generalizability of the findings. In addition, the short postintervention period may not have been sufficient to fully capture all the positive outcomes. Finally, the small sample size limited the statistical analysis and did not allow for significance to be shown. Future projects like this must necessarily contain a larger sample size if significance is to be demonstrated.

This project was undertaken at one academic nursing clinic owned by a nursing school and operated by an NP. Although all 44 records of patients who were diagnosed as having DM
were included in the study, only 26 (59%) records had postintervention data for analysis. Thus, we had a 41% drop-out rate during the project period. It is presumed that these patients chose to seek care elsewhere because of moving from the area, deciding to seek care from another practice, or dropping out of care altogether, or it is presumed that the patients are deceased. The 18 medical records that did not have postintervention data indicated that postcard reminders had been sent to the patients reminding them of the need for follow-up. Unfortunately, with this type of research, follow-up to determine why those 18 patients choose not to return to the clinic for care is unknown. The loss of 18 patients is a sizeable proportion of the total population of patients with DM and is of concern to the researchers. A future investigation should be designed to determine reasons why such patients leave an NP practice.

One question arises regarding the process improvement results of this project. Are the process improvement results actually because of what we did to our patients and the system or what we recorded in our EMR templates? Are we now more easily able to retrieve data at the end of the study versus the beginning of the project? We do not know the answer, but we do know that we are currently more systematically recording what we do to our patients with diabetes, which actually was one of the process improvements.

Although several interventions were implemented, they had a negligible effect on most of the physiological measurements studied with the exception of lowering LDL from a preintervention mean of 122.9 mg/dL to a postintervention level of 97.9 mg/dL. Achieving goal LDL levels in clinical practice is extremely difficult. One study, the Lipid Treatment Assessment Project, studied treatment of outpatient lipidemia and showed that only 18% of patients with coronary heart disease had achieved the National Cholesterol Education Program goal of 100 mg/dL (Pearson, Laurora, Chu, & Kafonek, 2000). Another study, the Heart and Estrogen/Progestin Replacement Study, revealed that only 10% of patients achieved an LDL cholesterol goal of 100 mg/dL (Julley et al., 1998). Given the results of these two large studies, it would appear that the postintervention mean LDL level of 97.9 mg/dL from this current study surpassed findings from other studies reviewed.

This quality improvement project attempted to transfer previous research knowledge about system change into action and then evaluate the results of those actions applied to the care of patients with diabetes. Further, it was an attempt to demonstrate how utilization of process changes in the clinical setting can positively impact outcomes for patients with diabetes.

Although medical records documented that patients were given instruction on exercise and diet, we found no statistically significant differences in blood pressure, weight, BMI, triglycerides, cholesterol, and high-density lipoprotein (HDL) level, all of which are known to be impacted by exercise, weight loss, and diet. Although the LDL levels pre- and postintervention are statistically significant, only six additional people (see Table 2) were placed on a statin. What is unknown is whether the people who were already on a statin had an increase in their dosage or the addition of a second agent, which was not

Table 2: System Indicators of Care

<table>
<thead>
<tr>
<th>Variable</th>
<th>Preintervention Data</th>
<th>Postintervention Data</th>
<th>% Change in “Yes” Response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes: No</td>
<td>Yes: No</td>
<td></td>
</tr>
<tr>
<td>Pneumococcal vaccine</td>
<td>1: 24</td>
<td>22: 4</td>
<td>95</td>
</tr>
<tr>
<td>Flu vaccine</td>
<td>4: 21</td>
<td>15: 11</td>
<td>73</td>
</tr>
<tr>
<td>Aspirin</td>
<td>10: 15</td>
<td>23: 3</td>
<td>57</td>
</tr>
<tr>
<td>Funduscopic exam</td>
<td>10: 15</td>
<td>22: 4</td>
<td>55</td>
</tr>
<tr>
<td>Exercise education</td>
<td>15: 10</td>
<td>23: 3</td>
<td>35</td>
</tr>
<tr>
<td>Alcohol education</td>
<td>14: 11</td>
<td>21: 4</td>
<td>34</td>
</tr>
<tr>
<td>Smoking cessation</td>
<td>16: 9</td>
<td>23: 3</td>
<td>30</td>
</tr>
<tr>
<td>Ophthalmology referral</td>
<td>14: 12</td>
<td>20: 6</td>
<td>30</td>
</tr>
<tr>
<td>Foot exam</td>
<td>16: 8</td>
<td>22: 4</td>
<td>27</td>
</tr>
<tr>
<td>Statin</td>
<td>16: 10</td>
<td>22: 4</td>
<td>27</td>
</tr>
<tr>
<td>Diet education</td>
<td>18: 7</td>
<td>24: 2</td>
<td>25</td>
</tr>
<tr>
<td>Urine analysis microalbumin</td>
<td>12: 13</td>
<td>15: 11</td>
<td>20</td>
</tr>
<tr>
<td>ACE inhibitor</td>
<td>16: 9</td>
<td>20: 6</td>
<td>20</td>
</tr>
<tr>
<td>Home glucose monitoring</td>
<td>16: 9</td>
<td>19: 7</td>
<td>16</td>
</tr>
<tr>
<td>Hypoglycemic agent</td>
<td>16: 10</td>
<td>19: 7</td>
<td>16</td>
</tr>
<tr>
<td>Thyroid-stimulating hormone</td>
<td>17: 8</td>
<td>16: 10</td>
<td>-6</td>
</tr>
<tr>
<td>Insulin</td>
<td>3: 22</td>
<td>2: 24</td>
<td>-50</td>
</tr>
</tbody>
</table>

Note: Totals may not add to 26 because of missing data.
investigated in this study. It is unclear to the research team why LDL levels should drop when there were no changes in weight or other levels of lipoproteins. Future projects and studies might also look at the other variables (exercise and diet) that affect LDL levels.

While this project had difficulty demonstrating statistical significance in the patient outcome variables, the systems variables were greatly improved. For example, the number of patients who received a pneumococcal vaccination increased from 1 in the preintervention period to 22 in the postintervention period. The systems variables were under the direct control of the project staff and improved, whereas the patient outcome variables are under the direct control of the patient. Thus, while we provided patients with information on diet and exercise, we have no control over whether the patient implemented the information. As we know, behavior change in patients is not an easy task. In future projects, information should be reinforced and patients should be asked what behavior changes they have made based on the information provided.

SUMMARY

This project sought to make systems-level and patient outcome variable changes in patients with diabetes based on the work of Heisler and Wagner (2004). Almost all the systems-level variables improved, while only one patient outcome variable had a statistically significant change from the preintervention to the postintervention period and that was a decrease in the level of LDL from a mean of 122.9 to 97.9. The systems-level variables were under the influence of the project team and easy to change; the patient outcome variables were under the influence of the patient, which made them more difficult to change.

REFERENCES


