

Feasibility and Effectiveness of System Redesign for Diabetes Care Management in Rural Areas

The Eastern North Carolina Experience

Purpose

Redesigning the system of care for the management of patients with type 2 diabetes mellitus has not been well studied in rural communities with a significant minority population and limited health care resources. This study assesses the feasibility and potential for cost-effectiveness of restructuring care in rural fee-for-service practices for predominantly minority patients with diabetes mellitus.

Methods

This was a feasibility study of implementing case management, group visits, and electronic registry in 5 solo or small group primary care practices in rural North Carolina. The subjects were 314 patients with type 2 diabetes mellitus (mean age = 61 years; 72% African American; 54% female). An advanced practice nurse visited each practice weekly for 12 months, provided intensive diabetes case management, and facilitated a 4-session group visit educational program. An electronic diabetes registry and visit reminder systems were implemented.

Results

There was an improvement in the percentage of patients achieving diabetes management goals and an improvement in productivity and billable encounters. The per-

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centage of patients with a documented self-management goal increased from 0% to 42%, a currently documented lipid panel from 55% to 76%, currently documented aspirin use from 25% to 37%, and currently documented foot examination from 12% to 54%. The average daily encounter rate improved from 20.17 to 31.55 on intervention days.

Conclusions

A redesigned care delivery system that uses case management with structured group visits and an electronic registry can be successfully incorporated into rural primary care practices and appears to significantly improve both care processes and practice productivity.

As the prevalence of obesity and type 2 diabetes mellitus continues to increase,¹ the challenge of providing comprehensive state-of-the-art care for this high-risk population grows. Of particular concern, the prevalence of diabetes has grown substantially in minority populations,^{1,2} further challenging us to provide services in a culturally competent manner. This challenge is even more compelling when services must be provided in rural underserved regions where there are often fewer providers and limited resources to improve care outcomes. Although not well studied in rural settings, consistent care management that is designed to follow evidence-based clinical practice guidelines appears to be associated with improved health outcomes.³ However, data from both the United States^{4,5} and Canada^{6,7} document that diabetes care management guidelines are not being consistently followed.

By contrast, previous controlled studies have clearly shown that redesigning systems of care for patients with type 2 diabetes mellitus can result in beneficial clinical outcomes⁸ as well as reductions in use of expensive health care resources.⁹ This redesigning of care has included intervening with providers,^{10,11} system processes,¹²⁻¹⁴ and patients¹⁴⁻¹⁶ and has usually included 1 or more of the following: new medical record/reminder systems, patient recall systems, care management by nurses and/or other providers, and group visits. Reminder systems have been successful in improving measures of the process of care^{12,13} but may not necessarily affect clinical

outcomes. By contrast, most care management studies that included a nurse or other clinician to follow up with and manage patients have demonstrated improvement in selected clinical outcomes.¹⁷

Recent system redesign efforts have explored the use of a collective or group visit format for patients with diabetes.¹⁴ Group education and mutual support provided through the collective care of patients with similar conditions represent an opportunity for both improved care and improved efficiency. Early evidence regarding group visits suggests a clear benefit.¹⁴ Sadur et al¹⁴ studied a group visit structure for providing care management to adults with diabetes in a health maintenance organization (HMO) setting in Northern California. These authors describe improved glycemic control as well as high patient satisfaction and a significantly lower utilization of health system resources (eg, hospitalization) as a result of the intervention.

Most of the studies of system redesign efforts have been conducted in structured managed care settings. By contrast, many rural settings do not have the collective resources, funding, and infrastructure to implement a comprehensive redesign of diabetes care management processes. Similarly, many system redesign efforts have not focused on the unique needs of minority patients to minimize disparate health outcomes. Consequently, no studies to date have evaluated the cost effectiveness of combining nurse-led care management with a group visit structure for minority diabetic patients in primary care practice settings in rural communities. The extent to which these system redesign efforts can be specifically targeted to improve racial disparities in diabetes care delivery in rural settings is unclear. The present study focuses on the initial feasibility and potential for cost-effectiveness of restructuring care for rural, primarily minority patients with diabetes mellitus. Specifically, this article details the major elements of this redesigned model of care delivery and documents the initial feasibility of the implementation of the model. The clinical outcomes from this project have been previously described.¹⁸

Methods

Project Context and Overview

Age-adjusted diabetes mortality rates in rural northeastern North Carolina are nearly double the national

average and 68% above the North Carolina average. A high percentage of the population in this region is African American, and approximately 20% of the population is at or below federal poverty levels.

This project is a joint endeavor of the Department of Care Management, University Health Systems of Eastern Carolina, Bertie Memorial Hospital, Roanoke-Chowan Medical Practices, and East Carolina University, Department of Family Medicine. The project, which began as a planning effort in October 2000, aims to document the feasibility of delivering improved clinical care using a cost-efficient methodology that involves reimbursable and uniform chronic disease management at 5 rural clinics that serve an estimated 3700 people with diabetes. Two of the sites are federally qualified rural health clinics, serve a disproportionately low-income population, and therefore receive cost-based Medicare and Medicaid reimbursements. The present study details the development of this model in these 5 rural clinics. The study was approved by the local Institutional Review Board, and consent for participation was obtained from all participants.

Selecting a Model for Change

The project's leadership studied the successful chronic care model developed by Ed Wagner of the MacColl Institute for Health Care Innovation in association with the Robert Wood Johnson Foundation and the Bureau of Primary Care¹⁹ (see Figure 1). The leadership team used this model to develop a 3-component redesign strategy. The project's timeline called for pilot implementation in 1 rural clinic and expansion to 4 additional rural practices. The major components of the redesigned system were as follows.

Clinic-based nurse case manager. Based on the work of Aubert et al¹⁷ and others,^{20,21} the leadership team hired a nurse with case management experience and advanced patient management skills in diabetes to serve as the major personnel intervention in the system redesign. The position was designated as a "nurse case manager." This individual facilitated the development of an education self-management protocol for individuals with diabetes mellitus that was agreed to and formalized by all physi-

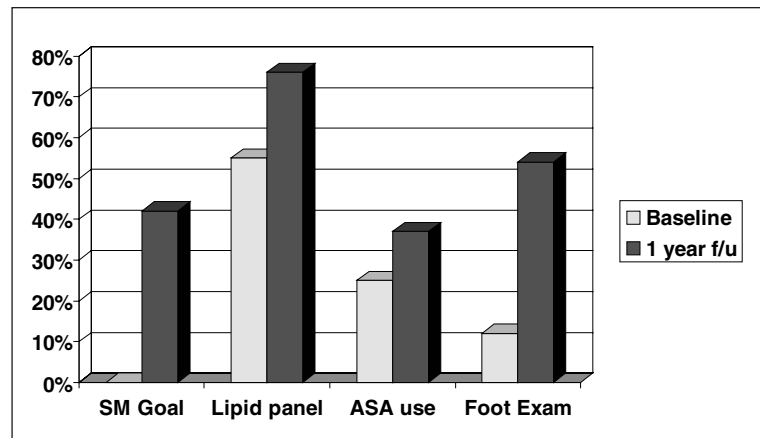


Figure 1. Improvement in process measures of diabetes care. f/u = follow-up; SM = self-management; ASA = aspirin. Reprinted with permission from Wagner.¹⁹

cian providers in these rural practices. Details of this protocol including a 4-part review of systems and a 4-part educational curriculum are available from the primary author. Prior to the present study, these patients had received no case management services and little patient education and were frequently served by a medical office assistant rather than a more skilled office provider.

All patients with diabetes mellitus in the 5 clinics in which active redesign was implemented were screened and encouraged to participate. However, patients with type 2 diabetes mellitus and with 1 or more of the following conditions were targeted to participate: HbA1c >7.0, blood pressure >135/85 mm Hg, or physical examination or laboratory evidence of high-risk end-organ disease including diabetic retinopathy, nephropathy, or neuropathy. The nurse case manager reviewed the patient's individual care plan relative to the standards of medical care published by the American Diabetes Association²² and facilitated or provided, under protocol and supervision, the contemporary diabetes care that was needed by each individual patient. This included facilitating laboratory testing as well as referrals to other providers. The case manager also facilitated a return visit schedule and worked with office staff to create a patient reminder system as well as a callback system for patients who missed appointments. This redesigned system of care employing an external nurse case manager was initially piloted in a single clinic site and was then expanded to 4 other sites. The nurse case manager rotated to different sites on different days and was euphemistically called a "circuit rider case manager."

Group visits. In addition to individualized case management, most patients were scheduled to participate in a series of 4 group visits that were coordinated for scheduling, to occur on the same day as the case management/physician visit. The purpose of the group visits was 2-fold. First, they provided an opportunity to deliver focused educational content and material to a group of up to 10 diabetic patients from the same practice at the same time. Second, these group visits provided a support group structure for often isolated rural patients. Details of this group visit process are available from the primary author.

Patient registry. To track patient progress, the leadership team implemented a registry system (Cardiovascular/Diabetes Electronic Management System [CVDEMS]) currently being used by chronic disease collaboratives. This system is designed to be specific for diabetes and cardiovascular disease and is in use in a number of federally qualified health centers around the country (www.healthdisparities.net). This system allows office staff to enter demographic information regarding each patient with diabetes mellitus into a clinic population registry. Through a series of queries, detailed patient and laboratory information is available to the nurse case manager and physician. This system is updated each time a patient returns for care or has laboratory or consultant information available. The system has functionality to provide summary reports at the patient, clinic, and program level. This system was queried monthly regarding specific goals of diabetes care developed by the Centers for Disease Control and Prevention (CDC; see Table 1). The CVDEMS allowed the case manager to give providers reminders regarding care standards and diabetes disease management goals.

The effectiveness of this model was measured by 2 sets of clinical data. The first was a pre- and postintervention comparison of HbA1c relative to that in a control practice without the intervention. These results have been previously published.¹⁸ Second, the effectiveness was measured by a set of 4 clinical process indicators including the proportion with a documented self-management goal, lipid panel in the past year, foot examination in the past year, and daily aspirin use.

Regarding the potential for cost-effectiveness, the following business plan assumptions were made at the time of initial implementation:

Table 1

Goals of Diabetes Care Used by the Care Manager

HbA1c <7%
At least 2 measured HbA1cs in the past year
Documentation of self-management goals
Angiotensin-converting enzyme inhibitor or angiotensin receptor blockers for cardiac risk reduction
Blood pressure less than 130/80 mm Hg
Lipid panel in the past year
Low-density lipoprotein cholesterol less than 100 mg/dL
Aspirin or other antithrombotic
Statin for cardiac risk reduction
Stop smoking
Dilated eye examination in the past year
Comprehensive foot examination in the past year
Microalbumin screening in the past year
Influenza and pneumococcal vaccination
Dental examination in the past year

1. sustainability is a critical issue in any chronic disease system redesign plan.
2. the nurse case manager would improve the efficiency and productivity of the provider to the extent that his or her costs would be funded by increased patient billing.
3. the nurse case manager would facilitate a net increase of 10 visits per day at each specific clinic location or a net increase of 40 visits per week from all clinics.
4. these patients' insurance providers are usually billed at a level 3 visit (CPT code 99213) with an average receipt of approximately \$68.55 per visit. It was agreed that the project would bill the rural practices \$29 per each patient seen (×10 patients per day = \$290) to reimburse the project for the support of the nurse case manager.
5. salary and fringe benefits for the nurse was \$49 725, requiring \$1160 (\$290/day × 4) in revenue per 4-day week for 43 weeks per year. The salary and fringe benefits of the nurse case manager was primarily grant funded for the first 2 years, after which her salary was at full risk.

The 3-part model and business plan was piloted initially in 1 rural practice¹⁸ and was then expanded to the other rural practices. Funding was for start-up costs and

did not compromise the business plan goals outlined above. The sustainability of the program was measured in terms of improved clinic productivity. The primary care physician's average daily encounters on group diabetes days was compared to the overall average daily encounters for that practice. To address the possibility that the apparent increase in productivity may simply be due to a shift in visits (from individual to group visits) rather than an actual increase, project staff studied a subsample of 10 patient charts from the initial practice site. These 10 patients' visit frequency was studied during the calendar year prior to the project and then during the project's first calendar year. The visits were analyzed for both total number and reason for visit or presenting problem.

Results

A total of 314 patients from 5 rural clinics met the inclusion criteria and were initially enrolled in the 1-year effectiveness study. Their mean age was 61 years; 72% were African American, and 54% were female. Improvement in glycemic control was noted and has been documented in a separate article.¹⁸ Process measures regarding the feasibility of delivering comprehensive diabetes care for this population were queried from the CVDEMS database (see Figure 1). The percentage of patients with a documented self-management goal increased from nearly 0% to 42%. Likewise, the percentage of patients with a currently documented lipid panel increased from an average at baseline of 55% to 76%, the percentage of patients with currently documented aspirin use increased from an average at baseline of 25% to 37%, and the percentage of patients with a currently documented foot examination increased from an average at baseline of 12% to 54%. Other diabetes care indicators showed no change. Practice staff members and providers uniformly embraced the provision of case management services by an external nurse case manager.

Patients reported that the group visits facilitated the provision of mutual encouragement and accountability between and among members of the group. Most patients verbalized appreciation for this support, which they described as a source of motivation to continue their individual efforts at behavior modification.

Regarding the potential for cost-effectiveness, the average daily encounter rate for the first 14 months of the project, a measure of physician's productivity, was

20.17. However, on the days when group visits were offered, the physician's average daily encounter rate increased to 31.55. The analysis of a subsample of 10 patients regarding visit frequency and reason for visit indicates that this subset of patients increased their visits from 54 to 96 from the prior year to the year following their first group diabetes visit. Furthermore, the gain was overwhelmingly with the presenting problem of diabetes. These patients increased their visits for diabetes more than 4-fold, from 11 diabetes-presenting problem visits in the prior year to 47 diabetes-presenting problem visits in the project's first year. Non-diabetes-presenting problem visits also increased, but only modestly, from 43 in the prior year to 47 in the project's first year. More important, these visits did not decline, and care received individually in the prior year was not simply shifted to a group mode in the project's first year. A similar analysis performed in year 3 at a different clinic site demonstrated a similar increase in diabetes-related visits.

The American Diabetes Association recommends a minimum of 4 visits per year for patients with high H_{A1c}. This analysis demonstrates that this clinic's practice failed to meet American Diabetes Association clinical standards prior to the group project and then achieved this standard after program implementation.

After the pilot experience with the CVDEMS system, the concern was raised that much of the information was duplicative of the medical record. Consequently, the leadership team began moving toward full implementation of Logician, a commercially available electronic health record. This system, yet to be fully installed, will be configured to provide many of the same functions of the CVDEMS program but will also allow for provider reminder systems and decision support tools.

Overall, investigators identified the following as key elements of the success of this redesigned system:

- focus on improved glycemic control;
- implementation in a local clinic, thus facilitating continuity of care;
- redesigning the diabetes care management tasks to improve efficiency and documentation;
- buy in and enthusiasm of the entire office staff, led by the physician;
- conjoint efforts of a locally effective interdisciplinary team of health professionals;

- improved charge capturing and reimbursement for group sessions; and
- careful and focused ongoing case management and care facilitation for the most complex patients.

The program continues active expansion in 5 clinics.

Discussion

This study documents the preliminary effectiveness and feasibility of a redesigned health care delivery system that emphasizes case management, group visits, and patient registry. Investigators have demonstrated the application of this system in the care of rural, predominantly minority patients with type 2 diabetes mellitus. Improvements in the process of diabetes care have been shown as well as expansion in productivity-revenue from the case management/group visit components. Improvements in the process of care outcomes add to existing literature on the effectiveness of case management and other redesigned elements.⁸ However, most of the prior studies have been completed in highly structured HMO or managed care settings. The present study suggests that many of these same outcomes can be achieved through similar interventions in rural, fee-for-service primary care settings that provide care for predominantly minority patients with type 2 diabetes mellitus. The magnitude of improvement in process outcomes is similar to that described in managed care settings and is consistent with national guidelines. Achievement of such standards of care can be expected to minimize future patient morbidity and delay patient mortality.

From a business perspective, the system redesign efforts resulted in a substantial increase in office productivity as measured by increased encounters. When projected out to multiple practices, the magnitude of increase in charges is sufficient to offset approximately 75% of the direct personnel costs of a “circuit rider” nurse case manager required to implement the redesigned system. Although not studied, these interventions may also be associated with decreased hospitalization and emergency department use. These significant outcomes, though preliminary, cannot be overemphasized. Even without calculating cost savings from reduced morbidity, a diabetes nurse case manager delivering care to rural minority patients has shown improved

clinical outcomes¹⁸ and can be nearly fully funded through fees for services. However, costs of system management, supervision, and quality control are not included. Nonetheless, implementation of this model demonstrates the potential for sustainability.

Limitations of this study include the lack of concurrent control clinics against which to compare system redesign improvements, the difficulty in separating out the relative effectiveness of the 3 concurrent interventions, the lack of documented improvement in 8 of the 13 CDC outcome indicators, the lack of measurements of all costs and outcomes associated with this system redesign, and the potential that this model may not generalize to urban or highly structured managed care settings.

In conclusion, this study demonstrates that care processes for underserved predominantly minority patients with type 2 diabetes mellitus in rural areas can be successfully redesigned to improve both processes of care and fiscal outcomes. Care redesign models for such areas should include the elements of case management, group visits, and electronic registries.

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