Diabetes Management Quality Improvement in a Family Practice Residency Program

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Background: **Diabetes is a devastating chronic disease. Although optimal diabetes control reduces chronic complications, actual provision of diabetes care frequently falls short of accepted guidelines. We wanted to determine whether locally developed diabetes care initiatives can result in improvements in the provision of diabetes care.**

Methods: **This study was a retrospective cohort analysis using Medicare claims and chart abstraction data to ascertain diabetes care indicator utilization rates at the Northeast Iowa Family Practice Clinic (NEIFPC), which serves as the training site for the Northeast Iowa Family Practice Residency Program. Diabetic patients receiving care at the NEIFPC during 1996, 1997, and 1998 were included. Diabetes care rates are compared with those of other Iowa practices.**

Diabetes initiatives included chart audits, glycosylated hemoglobin (HbA_{1c}) measurement reminder cards, educational symposia, an endocrinology outreach clinic, resident elective rotations, diabetes flow sheet utilization, pharmacist interface, and nursing foot-examination preparations. The primary outcome was the utilization rate of accepted diabetes care indicators.

Results: **Diabetic patients at NEIFPC had greater utilization of diabetes care indicators than did patients of Iowa collaborators in 1997 and 1998. NEIFPC patients had HbA_{1c} levels measured more frequently in 1997 and 1998 (84% and 88%, respectively) than did patients of Iowa collaborators (49% and 41%, respectively) ($P < .001$). The mean 1997 and 1998 HbA_{1c} levels of 7.32% and 7.25%, respectively, are impressive compared with that of Iowa collaborators (8.83% and 8.36%) ($P < .001$) and other published data (8.5%–10%). The percentage of NEIFPC patients with good glycemic control ($HbA_{1c} < 8\%$) was 75%, compared with the reported 50% of all US patients.**

Conclusions: **Our findings suggest that multimodal diabetes care quality improvement initiatives, applied longitudinally, can result in significant improvements in the provision and documentation of diabetes care. (J Am Board Fam Pract 2001;14:243–51.)**

Diabetes is a devastating chronic disease that affects 15.7 million Americans, of whom only 10.3 million have this condition diagnosed.[1] More than 70% of diabetic persons die of macrovascular disease associated with myocardial infarction and stroke. The Diabetes Control and Complications Trial has shown convincingly that improved glycemic control can substantially reduce the risk of microvascular complications in persons with type 1 diabetes.[2] More recently, the United Kingdom Prospective Diabetes Study[3] confirmed similar risk reduction in patients with type 2 diabetes. Even moderate reductions in hyperglycemia, hypertension, and dyslipidemia translate into markedly improved outcomes. The degree of glycemic exposure is best determined by measurement of glycosylated hemoglobin A (HbA_{1c}), which reflects the average glucose level for the preceding 2 to 3 months.[4]

Major treatment goals in the diabetic patient are to optimize blood glucose control, reduce weight, and normalize lipid abnormalities and blood pressure. The American Diabetes Association (ADA) clinical practice guidelines reflect these goals, including tight blood glucose control, with an HbA_{1c}

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of less than 7.0%.[5] Ensuring these diabetes care guidelines are incorporated into the daily practice of primary care providers requires substantial education and effort. Clearly there are shortcomings and variations in adherence to diabetes care recommendations in office-based primary care practice.[6] The mean level of HbA_{1c} for a population of patients and the percentage of patients cared for by a physician or a health care delivery system whose HbA_{1c} reading is below a specific level have been suggested as diabetes quality-outcome indicators. Risk stratification, although imperfect, is necessary to make fair comparisons.[7]

The Northeast Iowa Family Practice Clinic (NEIFPC) has used several quality initiative measures to increase provider compliance with national diabetes care guidelines. We report the cumulative success of these efforts in improving care of the NEIFPC diabetic population as compared with other Iowa physicians and with other published national data.

Methods

Relevant General Educational Interventions

Residents in the NEIFPC program have had point-of-care education through faculty staffing (which exists with all residency programs) since the program started in 1978. Since 1992, as part of a longitudinal educational curriculum, samples of the resident physicians' medical charts have been formally audited by physician faculty to ensure provision and documentation of adequate care. Residents are given direct feedback from these audits by means of a medical chart evaluation form. A pharmacist faculty member has had resident physician educational responsibilities since 1995. This pharmacist focuses on chronic disease management within the clinic. In 1998, the NEIFPC initiated a pharmacy residency program, and that resident also had considerable educational responsibilities.

Diabetes-Specific Educational Interventions

Since 1987, 1 of 6 residents take advantage of a yearly 1-week elective rotation at the International Diabetes Center in Minneapolis. During 1993, the NEIFPC conducted a 3-month project of attaching HbA_{1c} reminder cards to the medical records of all diabetic patients who were being evaluated that day. That same year the NEIFPC developed and still has a diabetes care flow sheet for clinic use. Additionally, there has been required or encouraged attendance at a local diabetes education symposium, which has been conducted annually since 1994. In 1996, the NEIFPC began requiring that nurses ask all diabetic patients who came to the clinic for diabetic follow-up visits to remove their shoes and stockings before the physician enters the examination room. Also begun in 1996 was a longitudinal educational exposure with a monthly University of Iowa Endocrinology Outreach Clinic. This experience includes a structured rotation of residents providing patient care with an endocrinologist in the clinic, as well as monthly didactic lectures to all residents.

Beginning in 1997, the NEIFPC facilitated a diabetes quality-improvement initiative with major local hospitals and clinic providers. The Iowa Foundation for Medical Care (IFMC) requested the opportunity to join that initiative, which led to the NEIFPC participation in the Diabetes Care Project. In 1997 the NEIFPC began to use the IFMC diabetes care flow sheet (replacing its previous flow sheet) in the medical chart for all diabetic patients (Figure 1). The flow sheet was provided by IFMC and was a primary instrument of their statewide Diabetes Care Project. This flow sheet incorporates recognized diabetes care indicators (tests, examinations, and education) as recommended by the ADA.[5] The primary goal of using the flow sheet was to provide a simple method to educate and assist physicians in improving their documentation and provision of diabetes care. A conference was held to inform all clinic physicians about correct use of the flow sheet before its implementation.

The cohort of patients for the statewide Diabetes Care Project were 1995–1996 Medicare beneficiaries who had been continuously eligible for fee-for-service Medicare Part B in Iowa. The IFMC defined as diabetic (for purposes of quality assessment) those patients who during this period either had a diagnosis of diabetes on at least one Part A claim or a diagnoses of diabetes for face-to-face services on at least two Part B claims. With the NEIFPC participation in the Diabetes Care Project, the IFMC provided NEIFPC with Medicare claims data for diabetic patients within the practice. Mean HbA_{1c} values are reported for patients with more than one measurement in a given period. Descriptions, time periods, and data collection source of each group used for comparisons are listed below:

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DIABETES CARE FLOWSHEET

Patient Name _____ Birth Date ___/___/___ Gender M___ F___

PAYER & PATIENT NUMBER:

Medicare _____

Medicaid _____

Other, please specify _____

CLINIC & PROVIDER:

Clinic _____

Location _____

Physician _____ UPIN _____

ONGOING CLINICAL MEASURES

	Initial Measurement		Subsequent Measurements					
	Date *mm/dd/yyyy*	Results	Date *mm/dd/yyyy*	Results	Date *mm/dd/yyyy*	Results	Date *mm/dd/yyyy*	Results
LABORATORY								
Hemoglobin A1c *At Least Annual*								
FASTING LIPID PROFILE								
Total Cholesterol *Annual*								
HDL Cholesterol *Annual*								
LDL Cholesterol *Annual*								
Fasting Triglycerides *Annual*								
Urinalysis for protein *Annual*		Pos Neg		Pos Neg		Pos Neg		Pos Neg
Quantitative/Semi-Quantitative Urine Protein*		Pos Neg		Pos Neg		Pos Neg		Pos Neg
Microalbumin**								
Creatinine *Annual*								
MONITORING	**Date**	**Results**	**Date**	**Results**	**Date**	**Results**	**Date**	**Results**
Diabetic Foot Exam *Annual*								
Dilated Eye Exam *Annual*								
Blood Pressure *Each Visit*								
Weight *Each Visit*								
Review Home Blood Glucose Monitoring *Each Visit*		Yes No		Yes No		Yes No		Yes No
PREVENTIVE CARE	**Date**	**Results**	**Date**	**Results**	**Date**	**Results**	**Date**	**Results**
Influenza Vaccination *Annual*								
Pneumococcal Vaccination								
Tobacco Counseling *PRN*		Nonsmoker Yes No		Nonsmoker Yes No		Nonsmoker Yes No		Nonsmoker Yes No
Diabetes Education *Each Visit*		Yes No		Yes No		Yes No		Yes No
Dietary Instruction *Each Visit*		Yes No		Yes No		Yes No		Yes No

Frequency recommendations are for stable diabetics based on ADA guidelines. More frequent monitoring is required for unstable diabetics.

*May be indicated in patients with proteinuria to assess the degree of nephropathy.

**May be indicated in patients without frank proteinuria to assess need for preventive treatment.

3/99

Iowa Foundation For Medical Care
The Sunderbruch Corporation-Nebraska
Illinois Foundation for Quality Health Care

Figure 1. Iowa Foundation for Medical Care diabetes care flow sheet.

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1. Iowa statewide-baseline (1 July 1995 to 1 January 1997) Medicare fee-for-service claims: baseline data for all 41,467 statewide diabetic patients, as defined above.
2. Iowa Diabetes Care Project baseline (1 July 1995 to 1 January 1997) Medicare fee-for-service claims: baseline data for 8,103 diabetic patients from all statewide practices (collaborators) that participated in the Diabetes Care Project and that required any augmentation of usual care, which could be use of a flow sheet, mini-clinic, podiatrist, dietitian, posters, or other unique parameters.
3. NEIFPC baseline (1 July 1995 to 1 January 1997) Medicare fee-for-service claims: local baseline data for 115 NEIFPC diabetic patients.
4. Iowa Diabetes Care Project flow sheet (aggregate) (calendar years 1997–1998) chart abstraction: data for 332 (1997) and 875 (1998) diabetic patients from other statewide clinics that participated in the Diabetes Care Project, which required use of the IFMC diabetes care flow sheet and submission of data.
5. NEIFPC flow sheet (calendar years 1997–1998) chart abstraction: local data for all 313 NEIFPC diabetic patients after the IFMC diabetes care flow sheet had been in use for 2 years. All charts were reviewed by 1 author (JES) to ensure that each patient met ADA criteria for the diagnosis of diabetes mellitus. Forty-five patients were not included in the 1998 analysis for the following reasons: patient was inactive (eg, moved, transferred care) (38), deceased (5), or transferred to long-term care facility (2). Patients new to the practice in 1998 were not added to the analysis; therefore, 268 patients remained for analysis.

Comparison of diabetes care indicator utilization between the groups was expected to provide an overall measure of success of the diabetes educational efforts at the NEIFPC compared with other Iowa physicians and in particular with other Iowa physician participants in the Diabetes Care Project. Claims data were compared separately from chart audit data, particularly for such items as eye examinations, because the audit data relied on physician input. Furthermore, audit data included all ages, and Medicare claim data were primarily from patients older than 65 years.

The chi-square test and Student's *t* test were used to compare qualitative and continuous variables, respectively. *P* values of .05 or less were considered to indicate statistical significance.

Results

IFMC analyzed NEIFPC Medicare claim forms (1 July 1995 to 1 January 1997) and compared the data with statewide baseline results. Table 1 shows baseline results from Medicare claim analysis for three diabetic patient groups: NEIFPC, Iowa statewide, and Iowa providers participating in the Diabetes Care Project. In general, baseline characteristics and indicator utilization rates among the three groups were similar. The NEIFPC patients were, however, significantly younger than statewide or Diabetes Care Project participants (mean ages: 68.9, 72.8, and 72.8 years, respectively). One notable exception was for HbA_{1c} measurements. NEIFPC diabetic patients were twice as likely to have these measurements obtained compared with statewide or Diabetes Care Project participants (78%, 39%, and 34%, respectively). Another notable exception was creatinine measurement, where the reverse was true (17%, 43%, and 48%, respectively). Dilated eye examinations were less frequent in NEIFPC diabetic patients (48%, 55%, and 62%, respectively). Home glucose monitoring was also an exception (0%, 6%, and 12%, respectively), but this service was not covered for claims submitted at this time.

We then requested expansion of the NEIFPC quality indicator measurements to all NEIFPC diabetic patients. The IFMC agreed to analyze these data as abstracted by research assistants from patient medical records to the IFMC diabetes care flow sheet. There were 313 diabetic patients in 1997 and 268 in 1998 whose data could be evaluated. Tables 2 through 5 summarize chart abstraction data obtained from all NEIFPC diabetic patients and from other statewide Diabetes Care Project participants (n = 332 in 1997 and n = 875 in 1998). The two groups were demographically similar by sex , but there was a 5-year difference in the mean ages of the two groups. The NEIFPC patients were significantly older ($P < .01$) than the patients of the other Iowa participants.

During 1997 and 1998, NEIFPC diabetic patients (83.7% and 88.1%) were much more likely to have HbA_{1c} measurements obtained compared

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Table 1. Patient Demographics and Diabetes Care Indicator Utilization for NEIFPC (NE), Iowa Providers (IA) Participating in the Diabetes Care Project, and Iowa Physicians Statewide.

Variable	No. (%)*			*P* Value		
	NE (N = 115)	Iowa Statewide (N = 41,467)	IA (N = 7,988)	NE vs Iowa Statewide	Iowa Statewide vs IA	NE vs IA
Primary care visits	110 (96)	36,070 (87)	7,724 (97)	<.001	<.001	.585
Demographics						
Age (y)–mean ± SD	68.9 ± 12.9	72.8 ± 9.6	72.8 ± 9.3	<.01	NS	<.01
Sex						
Male	47 (41)	21,694 (44)	3,526 (44)			
Female	68 (59)	17,304 (56)	4,462 (56)	.450	.706	.483
Unknown	0	2,469	0			
Laboratory						
Hemoglobin A_{1c}	90 (78)	16,120 (39)	2,735 (34)	<.001	<.001	<.001
Lipid panel	14 (12)	4,945 (12)	1,012 (13)	.935	.066	.872
Cholesterol	15 (13)	7,729 (19)	1,345 (17)	.075	<.001	.231
High-density lipoprotein	22 (19)	10,652 (26)	1,929 (24)	.074	.003	.175
Low-density lipoprotein	14 (12)	5,074 (12)	1,020 (13)	.984	.19	.846
Triglycerides	15 (13)	7,804 (19)	1,331 (17)	.066	<.001	.253
Urinalysis	62 (54)	17,607 (42)	3,986 (50)	.014	<.001	.391
Quantitative/semi-quantitative urine protein	5 (4)	390 (1)	36 (0.5)	.0173	<.001	.041
Microalbumin	3 (3)	1,381 (3)	517 (7)	.628	<.001	.011
Creatinine	19 (17)	17,938 (43)	3,866 (48)	<.001	<.001	<.001
Monitoring						
Dilated eye examination	55 (48)	22,846 (55)	4,926 (62)	.119	<.001	.003
Home blood glucose†	0 (0)	2,437 (6)	957 (12)	<.001	<.001	<.001
Preventive care						
Influenza vaccination	66 (57)	21,349 (52)	4,977 (62)	.201	<.001	.290
Pneumococcal vaccination‡	16 (14)	4,018 (10)	908 (11)	.191	<.001	.433

Note: Data are from analysis of Medicare fee-for-service claims.
NEIFPC—Northeast Iowa Family Practice Residency Clinic.
*Number and percentage of patients receiving service or test at least once in time frame.
†Medicare did not pay for home blood glucose monitors for patients with non-insulin-dependent diabetes until 1 July 1998.
‡Pneumococcal pneumonia vaccination is reported for the period specified in claims data.

with the aggregate group (48.8% and 40.7%), for each respective year. Overall, mean HbA_{1c} measurements were substantially lower for NEIFPC patients when compared with the state aggregate group (1997, 7.32% vs 8.83%; 1998, 7.25% vs 8.36%, respectively) (Table 3). Both the increased

Table 2. Patient Demographics for NEIFPC (NE) and Iowa Providers (IA) Participating in the Diabetes Care Project.

Demographic Variable	NE 1997 (n = 313)	IA 1997 (n = 332)	NE 1998 (n = 268)	IA 1998 (n = 875)
Age (y), mean ± SD	60 ± 15.5*	55 ± 15.5	61 ± 15.0*	56 ± 17.2
Sex, No. (%)				
Male	141 (45.0)	131 (39.5)	118 (44.0)	398 (45.4)
Female	172 (55.0)	199 (59.9)	150 (56.0)	466 (53.3)
Unknown	0	2 (0.6)	0	11 (1.3)

Note: Data are from analysis of chart abstractions.
NEIFPC—Northeast Iowa Family Practice Residency Clinic.
*$P < .01$ for comparison with Iowa Providers within same year.

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Table 3. Glycemic Monitoring and Control for NEIFPC (NE) and Iowa Providers (IA) Participating in the Diabetes Care Project.

Variable	No. (%)*				*P* Value			
	NE 1997 (n = 313)	IA 1997 (n = 332)	NE 1998 (n = 268)	IA 1998 (n = 875)	NE 1997 vs IA 1997	NE 1998 vs IA 1998	NE 1997 vs NE 1998	IA 1997 vs IA 1998
Hemoglobin A_{1C}	262 (83.7)	162 (48.8)	236 (88.1)	356 (40.7)	<.001	<.001	.130	.011
≥9.5%	23 (8.8)	55 (34.4)	24 (10.3)	72 (20.9)	<.001	<.001	.576	.002
8.0–9.4%	41 (15.6)	34 (21.3)	26 (11.1)	95 (27.5)	.155	<.001	.136	.119
7.0–7.9%	59 (22.5)	32 (20.0)	60 (25.6)	106 (30.7)	.537	.179	.417	.008
<7.0%	139 (53.1)	39 (24.4)	124 (53.0)	72 (20.9)	<.001	<.001	.989	.385
Mean	7.32%	8.83%	7.25%	8.36%	<.001	<.001	.605	.020

Note: Data are from analysis of chart abstractions.
NEIFPC—Northeast Iowa Family Practice Residency Clinic.
*Those receiving service at least once during time frame.

frequency of measuring HbA_{1c} and lower HbA_{1c} values for the NEIFPC were significantly different ($P < .001$) from the Iowa participants in each year. Concern existed that these differences might be due to the age differences between the two groups. To examine for this possibility, we ran regression models that analyzed the effects of both the age and group factors. A logistic regression test showed that age did not affect the proportion of patients that had HbA_{1c} measurements, but the odds ratio indicated that NEIFPC patients were 8.7 (95% confidence interval [CI] = 6.6–11.5) times more likely to have had an HbA_{1c} measurement. Analysis of variance tests showed that while both age and group were significant factors affecting the difference in HbA_{1c} values, they also showed that group remains a significant factor when controlling for age. We therefore concluded that differences between the two groups are retained even after adjusting for age.

During this 2-year interval NEIFPC patients had significantly more frequent laboratory measurements than the aggregate group for all laboratory diabetes care indicators: lipid panel, serum cholesterol, high-density lipoprotein, low-density lipoprotein, triglycerides, urinalysis, quantitative urine protein, serum creatinine, and HbA_{1c} (Table 4). Significantly greater utilization was also ob-

Table 4. Laboratory Indicator Utilization for NEIFPC (NE) and Iowa Providers (IA) Participating in the Diabetes Care Project.

Variable	No. (%)*				*P* Value			
	NE 1997 (n = 313)	IA 1997 (n = 332)	NE 1998 (n = 268)	IA 1998 (n = 875)	NE 1997 vs IA 1997	NE 1998 vs IA 1998	NE 1997 vs NE 1998	IA 1997 vs IA 1998
Lipid panel	115 (36.7)	64 (19.3)	142 (53.0)	234 (26.7)	<.001	<.001	<.001	.005
Cholesterol	164 (52.4)	118 (35.5)	154 (57.5)	287 (32.8)	<.001	<.001	.220	.372
High-density lipoprotein	125 (39.9)	76 (22.9)	149 (55.6)	252 (28.8)	<.001	<.001	<.001	.033
Low-density lipoprotein	119 (38.0)	67 (20.2)	145 (54.1)	238 (27.2)	<.001	<.001	<.001	.009
Triglycerides	159 (50.8)	78 (23.5)	153 (57.1)	264 (30.2)	<.001	<.001	.128	.017
Urinalysis	112 (35.8)	42 (12.7)	105 (39.2)	84 (9.6)	<.001	<.001	.399	.142
Quantitative urine protein	13 (4.2)	3 (0.9)	33 (12.3)	24 (2.7)	.009	<.001	<.001	.015
Microalbumin	48 (15.3)	68 (20.5)	97 (36.2)	197 (22.5)	.087	<.001	<.001	.439
Creatinine	198 (63.3)	151 (45.5)	154 (57.5)	315 (36.0)	<.001	<.001	.154	.003

Note: Data are from analysis of chart abstractions.
*Number and percentage of patietns receiving service at least once in time frame.
NEIFPC—Northeast Iowa Family Practice Clinic.

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Table 5. Preventative and Monitoring Services Utilization for NEIFPC (NE) and Iowa Providers (IA) Participating in the Diabetes Care Project.

Variable	No. (%)*				*P* Value			
	NE 1997 (n = 313)	IA 1997 (n = 332)	NE 1998 (n = 268)	IA 1998 (n = 875)	NE 1997 vs IA 1997	NE 1998 vs IA 1998	NE 1997 vs NE 1998	IA 1997 vs IA 1998
Diabetic foot	167 (53.4)	39 (1.7)	170 (63.4)	173 (19.8)	<.001	<.001	.013	<.001
Dilated eye examination	37 (11.8)	74 (22.3)	113 (42.2)	371 (42.4)	<.001	.945	<.001	<.001
Home blood glucose monitoring	110 (35.1)	99 (29.8)	139 (51.9)	186 (21.3)	.149	<.001	<.001	.003
Influenza vaccination	112 (35.8)	45 (13.6)	72 (26.9)	434 (49.6)	<.001	<.001	.020	<.001
Pneumococcal vaccination	87 (27.8)	68 (20.5)	92 (34.3)	129 (14.7)	.030	<.001	.090	.023
Diabetes education	91 (29.1)	87 (26.2)	131 (48.9)	244 (27.9)	.416	<.001	<.001	.555
Dietary instruction	67 (21.4)	47 (14.2)	117 (43.7)	118 (13.5)	.016	<.001	<.001	.764
Tobacco counseling	16/17 (4.1)	13/18 (72.2)	15/16 (93.8)	20/31 (64.5)	.068	.005	.965	.571

Note: Data are from analysis of chart abstractions.
*Number and percentage of patients receiving service at least once in time frame.
NEIFPC—Northeast Iowa Family Practice Residency Clinic.

served with NEIFPC patients for the following monitoring and preventive care indicators: diabetic foot examination, pneumococcal vaccination, and dietary instruction. In 1998 NEIFPC also had significantly greater utilization of microalbumin measurements, home blood glucose monitoring, diabetes education, and tobacco counseling (Tables 4 and 5).

We reviewed within group changes of indicator utilization from 1997 to 1998. In 1998 the NEIFPC reported significantly increased utilization for the following indicators: lipid panel, high-density lipoprotein, low-density lipoprotein, microalbumin, quantitative urine protein, diabetes foot examination, dilated eye examination, home blood glucose monitoring, diabetes education, and dietary education. In the same group, decreased utilization was observed for influenza vaccination. The increase in home blood glucose monitoring might have been partly due to expanded Medicare coverage for this product in 1998.

Overall, the state aggregate group had lower initial indicator utilization rates in 1997 compared with the NEIFPC group. The former group showed substantial improvement, however, in using many indicators during 1998, including lipid panel, high-density lipoprotein, low-density lipoprotein, triglycerides, quantitative urine protein, diabetic foot examination, dilated eye examination, and influenza vaccine. This group declined in indicator utilization rates for of HbA_{1c}, creatinine, home blood glucose monitoring, and pneumococcal vaccination.

Discussion

The initial analysis of Medicare claims revealed that the NEIFPC group was substantially more likely to measure HbA_{1c} levels than either the Iowa statewide or Diabetes Care Project groups. In fact, the NEIFPC utilization of HbA_{1c} measurements is greater than previous reports from other states, where Medicare claims were used as the data source.[6] We are uncertain why the NEIFPC utilization of eye examinations was lower than the statewide cohort. Expansion of the analysis to include chart abstractions allowed further comparisons between groups. For both years, nearly every diabetes care quality indicator was more frequently utilized in the NEIFPC group than the state aggregate group. Considering mean HbA_{1c} values and the percentage of patients with HbA_{1c} values of less than 8.0% in each group, the NEIFPC diabetic patients experienced better glycemic control on average than their counterparts, with 76% of patients in 1997 and 78% of patients in 1998 having HbA_{1c} values of less than 8% compared with 44% and 52%, respectively, for their counterparts. NEIFPC findings were also superior to NHANES III data, which showed about one half of US patients in good control.[4]

This latter point is particularly striking, when viewed along with the ADA goal for glycemic control ($HbA_{1c} < 7\%$) and where further actions are suggested for patients with HbA_{1c} levels greater than 8.0%.[5] The NEIFPC HbA_{1c} levels of 7.32% (1997) and 7.25% (1998) are much lower than the

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mean HbA_{1c} value of 8.5% reported from an internal medicine residency.[8] They are also lower than the levels of 10% and 9.5%, respectively, for type 1 and type 2 diabetes patients included in the Wisconsin Study of Diabetic Retinopathy.[9] Another primary care study revealed average HbA_{1c} levels of 10% and 8.9%, respectively, in type 1 and 2 diabetes patients.[10] In a health maintenance organization system, an intervention clinic with a continuous quality improvement initiative had a mean HbA_{1c} level of 7.9% at 18 months compared with 8.8% in a comparison clinic.[11]

Assessing diabetes care by medical record review has been used for comparison of data for many years.[12] Multiple studies in a variety of primary care settings show poor compliance with ADA guidelines, with foot examination documentation ranging from 6% to 48% and HbA_{1c} levels ranging from 44% to 84%.[7] The NEIFPC data were 53% and 64%, and 84% and 88%, respectively, for those parameters in 1997 and 1998.

One obvious discrepancy between Medicare claims and chart abstraction data deserves greater explanation. For all groups, Medicare claims showed better utilization of dilated eye examinations than did review of medical chart abstractions. This large discrepancy between sources is assumed to be due to a recording deficiency regarding care received by patients outside the NEIFPC clinic.

Despite the overall positive findings, the NEIFPC still has inadequate utilization of several indicators. Chart abstractions showed that only 29% of the IFMC diabetes care flow sheets were entirely completed and used by clinic physicians. Regrettably, this flow sheet usage rate is similar to that of a recent report (33% usage), where a positive effect on diabetes care was observed even with suboptimal flow sheet utilization.[13] Modifying behaviors are more important than flow sheet utilization, which is only a tool. Several indicators for the NEIFPC site were still typically utilized or documented less than 50% of the time: dilated eye examinations, microalbumin measurements, diabetes education, and dietary instruction. Microalbumin testing has only recently been included as a practice standard, however, and NEIFPC utilization rates increased from 15% to 36% between 1997 and 1998. The same is true for dilated eye examinations, where NEIFPC documentation increased from 12% to 42%. We believe this increase is due to educational efforts that promoted questioning about and documentation of that service.

Continuous quality improvement initiatives for diabetic populations at other family medicine residency programs have resulted in improved compliance with recommended indicator utilization.[14] Health maintenance organizations have included reminders and visit note templates in electronic medical record systems, educational outreach visits, weekly patient education clinics, and continuous quality improvement chart stamps.[15] The Veterans Administration primary care clinics have shown that pharmacists can have a positive impact on glycemic control.[16] In South Carolina a legislative initiative was created in 1994 that promoted statewide education, surveillance, research, and current treatment modalities. Collaborative and interdisciplinary diabetes management programs have also been created at the two medical schools in that state.[17] There is no singular before-and-after diabetes care initiative by which its influence can be measured on practice separately. Rather, we believe the cumulative effect from previous and ongoing initiatives (ie, the "dripping faucet" effect) most likely explains why the NEIFPC data are so encouraging. The potential for projects working with residents is high as this new cohort of physicians is taught quality improvement efforts.

Preliminary data analysis for 1999 and 2000 shows an increasing improvement in utilization of indicators for the NEIFPC practice. Additional analysis for individual providers has been done to facilitate educational feedback to physician residents, which is an essential part of family practice residency training. Improving physician guideline adherence however, might not be generalizable, because barriers in one setting might not exist in another.[18]

Strengths and Limitations

The strengths of our study include the multiple types of diabetes care indicators evaluated, that the data reflect a real-world community-based clinical practice, inclusion of all NEIFPC diabetic patients, and review of all charts to ensure the entire group met ADA criteria for the diagnosis of diabetes mellitus.

The primary limitation of our study relates to the retrospective nature of the data. We are unable to determine specifically which individual interventions were helpful or to what degree. This places

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our report in a descriptive context. The intent of this report, however, is to describe a system-wide approach to improving diabetes care that incorporates multiple efforts administered over a continuum of time, which is usually true of quality improvement efforts. We are also unable to determine what concurrent quality improvement practices existed in the Iowa provider's group beyond the required IFMC diabetes flow sheet utilization.

Conclusion

Our study findings suggest that locally developed diabetes care quality improvement initiatives, when applied in a longitudinal manner, will result in substantial improvements in the provision and documentation of diabetes care.

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