Effect of a Managed Care Disease Management Program on Diabetes Care

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Objective: To determine if processes and outcomes of diabetes care improved between 2000 and 2006 in a managed care health plan with a comprehensive diabetes disease management program.

Study Design: Cross-sectional.

Methods: A total of 1650 randomly selected members with diabetes mellitus completed surveys in 2000, and 1256 randomly selected members with diabetes completed surveys in 2006. Survey and medical record data were analyzed using multivariable regression and predictive probabilities adjusted for age, education, and comorbidities.

Results: In 2006, patients were more likely to have proteinuria assessed (85% vs 74% in 2000), foot examinations performed (90% vs 86%), glycosylated hemoglobin levels measured (94% vs 87%), lipids measured (81% vs 70%), aspirin use recommended (67% vs 56%), and influenza immunizations administered (70% vs 63%). Glycosylated hemoglobin levels decreased by 0.60% (P <.001), systolic blood pressures by 3 mm Hg (P = .002), and low-density lipoprotein cholesterol levels by 18 mg/dL (P <.001). Those who were continuously enrolled in the health plan were significantly more likely to report having had dilated retinal examinations (P = .003), aspirin use recommendations (P = .049), influenza immunizations (P = .004), and lower low-density lipoprotein cholesterol levels (by 6 mg/dL, P = .003).

Conclusions: Implementation of a disease management program was associated with substantial improvements in processes and outcomes of diabetes care over 6 years. Although secular trend likely contributed somewhat, improvement in other measures was significantly associated with duration of enrollment in the health plan, making secular trend an unlikely explanation for all of our findings.

(Am J Manag Care. 2009;15(9):575-580)

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Despite a strong evidence base for diabetes care,[1-5] it remains suboptimal in routine clinical practice.[6] Population-based care management strategies—including establishment of registries, dissemination of guidelines, self-management support, care management, tailored patient and provider feedback, enhanced clinical information systems, and expansion of benefits—have been shown to improve care for persons with chronic diseases.[7,8] These approaches to care underlie the chronic care model and disease management.[7,8] Despite optimism regarding the benefits of interventions based on these strategies, improved processes of care have not been consistently linked to improved intermediate outcomes.[8-11]

Between 1986 and 2007, the University of Michigan implemented an independent practice association model managed care health plan, M-CARE. The plan contracted with the University of Michigan and 42 other independent practice associations across southeastern Michigan. Approximately 5% of primary care providers were employed by the University of Michigan, and 29% of patients with diabetes received care from university providers. M-CARE integrated several care management strategies into a health plan–directed diabetes disease management program. M-CARE established a diabetes registry, disseminated guidelines, incorporated nurse care management, expanded benefits for members, and implemented targeted reminders for patients and providers to improve processes of care (eye examinations, renal screening, foot examinations, glycosylated hemoglobin [A1C] and lipids testing, and influenza immunizations) and intermediate outcomes of care (aspirin use, smoking cessation, angiotensin-converting enzyme or angiotensin receptor blocker use, and A1C and low-density lipoprotein [LDL] cholesterol control). M-CARE provided members access to diabetes education and nutritional counseling with no copayments, gave discounts for commercial weight-loss programs, covered smoking cessation classes and pharmacologic aids to smoking cessation with no copayments, offered self-monitoring supplies and insulin with no copayments, and waived referral requirements and copayments for diabetic eye examinations.

The objective of this study was to assess the effect of M-CARE's comprehensive diabetes disease management program. We determined if processes and outcomes of diabetes care improved between 2000 and 2006.

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Take-Away Points

Processes and outcomes of diabetes care improved substantially over 6 years in a managed care health plan with a comprehensive diabetes disease management program.

- It is likely that secular trend contributed to some of the improvement in processes and outcomes.
- Improvements in processes and outcomes were significantly associated with duration of enrollment in the health plan.

METHODS

The study has been described elsewhere.[12] It was performed at the University of Michigan site of Translating Research Into Action for Diabetes, a prospective observational study of diabetes care in managed care. The University of Michigan Institutional Review Board approved the study, and all participants provided informed consent.

In 2000 and again in 2006, patients with diabetes mellitus who were 18 years or older, community dwelling, enrolled in the health plan for at least 18 months, not pregnant, and had at least 1 claim for health services were sampled at random from the health plan and were surveyed and had their medical records reviewed. There were 3972 eligible patients with diabetes in 2000 and 3652 eligible patients with diabetes in 2006. A total of 1650 patients completed the survey by computer-assisted telephone interview or by mail in 2000, and 1256 patients completed the survey by mail in 2006. If we assume that patients unable to be contacted had the same rate of eligibility as those contacted and were counted in the denominator, survey response rate was 69% in 2000 and 54% in 2006. For the present analyses, we included patients who had both survey and medical record data (1349 patients in 2000 and 1050 patients in 2006).

In 2000 and 2006, processes of care were assessed over a 12-month period (except where noted) and included dilated retinal examinations, urine microalbumin or protein testing, foot examinations, A1C and lipids testing, aspirin use (measured over an 18-month period) or recommendation to take aspirin, and influenza immunization. We based performance of dilated retinal examinations, foot examinations, and aspirin use or recommendation to take aspirin on self-report or medical record documentation. Influenza immunization was based on self-report, and urine, A1C, and lipids testing was based on documentation in the medical record. Intermediate health outcomes were defined as the last recorded values for systolic and diastolic blood pressures and for A1C and LDL and total cholesterol levels.

We stratified the populations by age and performed bivariate analyses using *t* tests for continuous variables and χ^2 tests for categorical variables. We also performed multivariable regression analyses adjusted for age, education, and comorbidities. We used logistic regression models to derive the adjusted (conditional) predicted probabilities of each outcome.[13] Conditional predicted probabilities may be interpreted as the percentage of persons receiving each process of care adjusted for age, education, and comorbidities. All analyses were performed using SAS (version 9.1.3, service pack 4; SAS Institute, Cary, NC).

RESULTS

Between 2000 and 2006, the managed care organization stopped offering Medicare managed care. As a result, the percentage of persons with diabetes 65 years or older decreased from 50% to 6%, and the 2006 population was significantly younger (mean [SD] age, 62 [14] years in 2000 vs 52 [10] years in 2006). There were statistically significant changes in the distribution of education, diabetes treatment, and comorbidities between 2000 and 2006 and a small increase in the mean body mass index (**Table 1**).

The percentage of persons who received 6 of 7 processes of care improved between 2000 and 2006, as did intermediate health outcomes. Among patients aged 18 to 44 years, there was significant improvement in rates of lipids testing and aspirin use or recommendation to take aspirin, as well as in A1C and LDL and total cholesterol levels (Table 1). Although blood pressure did not improve, the mean systolic and diastolic blood pressures were at goal (<130 and <80 mm Hg, respectively) at both time points. Among patients aged 45 to 64 years, there was significant improvement in urine microalbumin or protein, A1C, and lipids testing, as well as in aspirin use or recommendation to take aspirin, influenza immunization, systolic blood pressure, and A1C and LDL and total cholesterol levels. Among patients 65 years or older, all processes of care except dilated retinal examinations and aspirin use or recommendation to take aspirin and all intermediate health outcomes improved significantly.

After adjusting for age, education, and comorbidities, patients in 2006 were more likely to have urine microalbumin or protein assessed, foot examinations performed, A1C tested, and lipids evaluated and to report aspirin use or recommendation to take aspirin (**Table 2**). They were also more likely to receive influenza immunizations. Statistically significant improvements were seen in all intermediate health outcomes. The A1C level decreased by 0.60% (to convert A1C level to proportion of total hemoglobin, multiply by 0.01), systolic blood pressure by 3 mm Hg, diastolic blood pressure by 1 mm Hg, LDL cholesterol level by 18 mg/dL, and total cholesterol

Table 1. Characteristics of the Study Populations With Diabetes and Diabetes Processes of Care and Intermediate Health Outcomes in 2000 and 2006[a]

Variable	2000 (n = 1349)	2006 (n = 1050)	*P*
Patient Characteristics			
Age group, y, No. (%)			<.001
18-44	168 (13)	245 (23)	
45-64	508 (38)	737 (70)	
≥65	673 (50)	65 (6)	
Age, mean (SD), y	61 (14)	51 (10)	<.001
Male sex, No. (%)	661 (49)	513 (49)	.94
Race/ethnicity, No. (%)			.07
Hispanic	33 (3)	37 (4)	
Black	150 (12)	120 (12)	
White	1021 (79)	772 (75)	
Asian/Pacific Islander	18 (1)	18 (2)	
Other	77 (6)	87 (8)	
Education, No. (%)			<.001
≤High school graduate	613 (46)	212 (20)	
≥Some college	719 (54)	834 (80)	
Body mass index, mean (SD)[b]	31.6 (7.3)	33.4 (8.4)	<.001
Diabetes treatment, No. (%)			<.001
Diet only	60 (4)	84 (8)	
Oral medication	763 (57)	551 (53)	
Insulin and oral medications	169 (13)	187 (18)	
Insulin only	357 (27)	228 (22)	
Duration of diabetes, mean (SD), y	13 (11)	11 (10)	<.001
Charlson Comorbidity Index, mean (SD)	2.45 (1.63)	1.73 (1.25)	<.001
Processes of Care by Age Group			
Dilated retinal examination performed, %			
18-44 y	73	77	.36
45-64 y	81	82	.58
≥65 y	81	88	.20
Urine microalbumin or protein assessed, %			
18-44 y	70	76	.16
45-64 y	76	87	<.001
≥65 y	74	91	.003
Foot examination performed, %			
18-44 y	89	90	.62
45-64 y	87	90	.10
≥65 y	85	94	.04
Glycosylated hemoglobin tested, %			
18-44 y	86	91	.11
45-64 y	88	95	<.001
≥65 y	86	98	.004

(Continued)

Table 1. Characteristics of the Study Populations With Diabetes and Diabetes Processes of Care and Intermediate Health Outcomes in 2000 and 2006[a] *(Continued)*

Variable	2000 (n = 1349)	2006 (n = 1050)	*P*
Processes of Care by Age Group *(Continued)*			
Lipids tested,%			
18-44 y	60	70	.04
45-64 y	73	82	<.001
≥65 y	69	84	.01
Aspirin use or recommendation to take aspirin, %			
18-44 y	26	41	.001
45-64 y	59	69	.001
≥65 y	70	82	.05
Influenza immunization obtained, %			
18-44 y	50	59	.07
45-64 y	60	68	.005
≥65 y	73	86	.02
Intermediate Health Outcomes by Age Group, Mean (SD)			
Glycosylated hemoglobin level, %			
18-44 y	8.50 (1.89)	7.84 (1.82)	<.001
45-64 y	8.03 (1.72)	7.41 (1.55)	<.001
≥65 y	7.56 (1.47)	6.93 (1.31)	.001
Systolic blood pressure, mm Hg			
18-44 y	124 (17)	124 (16)	.88
45-64 y	132 (18)	129 (15)	.002
≥65 y	138 (19)	130 (15)	<.001
Diastolic blood pressure, mm Hg			
18-44 y	76 (11)	75 (11)	.19
45-64 y	77 (10)	76 (10)	.13
≥65 y	75 (11)	72 (9)	.05
Low-density lipoprotein cholesterol level, mg/dL			
18-44 y	106 (31)	94 (28)	<.001
45-64 y	110 (35)	90 (30)	<.001
≥65 y	109 (34)	85 (32)	<.001
Total cholesterol level, mg/dL			
18-44 y	192 (40)	173 (37)	<.001
45-64 y	196 (47)	170 (39)	<.001
≥65 y	192 (43)	166 (42)	<.001

[a]The number of patients varies because of missing survey responses.
[b]Calculated as weight in kilograms divided by height in meters squared.

level by 24 mg/dL (to convert cholesterol level to millimoles per liter, multiply by 0.0259). The proportion of patients with A1C level less than 7%, blood pressure less than 130/80 mm Hg, and total cholesterol level less than 200 mg/dL improved from 6% in 2000 to 19% in 2006.

To further assess the effect of the health plan's comprehensive diabetes disease management program on processes and outcomes of care, we stratified respondents by duration of enrollment in the health plan, a measure of disease management program exposure, and reassessed processes and outcomes of

care. In the 2006 survey, 830 of 1256 respondents (66%) reported that they had been continuously enrolled in the health plan for 5 years or longer. After adjusting for age, education, and comorbidities, those who were continuously enrolled were significantly more likely to have had dilated retinal examinations (odds ratio [OR], 1.66; 95% confidence interval [CI], 1.19-2.30, P = .003) and influenza immunizations (OR, 1.51; 95% CI, 1.14-2.00, P = .004) and to report aspirin use or recommendation to take aspirin (OR, 1.32; 95% CI, 1.00-1.75, P = .049). They also had lower diastolic blood pressure (by 2 mm Hg, P = .009) and lower LDL (by 6 mg/dL, P = .003) and total (by 7 mg/dL, P = .02) cholesterol levels than those who had been continuously enrolled for less than 5 years but longer than 18 months.

Table 2. Predicted Probability of Diabetes Processes of Care Occurring and Changes in Intermediate Health Outcomes Between 2000 and 2006 Adjusted for Age, Education, and Comorbidities

Variable	Value Predicted Probability, %	
Processes of Care, %	**2000**	**2006**
Dilated retinal examination performed	80	81
Urine microalbumin or protein assessed	74	85[a]
Foot examination performed	86	90[b]
Glycosylated hemoglobin tested	87	94[a]
Lipids tested	70	81[a]
Aspirin use or recommendation to take aspirin	56	67[a]
Influenza immunization obtained	63	70[b]
Intermediate Health Outcomes	**Change in 2006 vs 2000**	***P***
Glycosylated hemoglobin level, %	–0.60	<.001
Systolic blood pressure, mm Hg	–2.55	.002
Diastolic blood pressure, mm Hg	–1.27	.01
Low-density lipoprotein cholesterol level, mg/dL	–17.95	<.001
Total cholesterol level, mg/dL	–24.23	<.001

[a] P <.001.
[b] P <.01.

DISCUSSION

After 6 years of comprehensive diabetes disease management, 6 of 7 diabetes processes of care and all measured intermediate health outcomes improved significantly. In 2006, the mean systolic and diastolic blood pressures and LDL cholesterol levels for the population were at goal. Longer duration of enrollment in the health plan, a measure of exposure to care management, was associated with a greater likelihood of having dilated retinal examinations, influenza immunizations, lower diastolic blood pressure, and LDL cholesterol levels and of reporting aspirin use or recommendation to take aspirin.

Many of the components of the disease management program were initiated between 1995 and 1999, including establishment of a registry, dissemination of guidelines to providers and patients, enhanced clinical information systems, and care management. Improvements in the targeting and tailoring of patient and provider feedback and expansion of benefits occurred largely between 2001 and 2005. Therefore, our initial cross-sectional survey in 2000 assessed the effect of care enhanced by traditional elements of care management, and the follow-up survey in 2006 assessed the effect of further improvements in delivery system design, including waiving copayments and expanding benefits. Our results suggest that these population-based care management strategies, including innovative changes in insurance benefit design, may improve the processes and outcomes of diabetes care. Future studies should explore the independent contribution of traditional care management strategies and more innovations in delivery system design.

We acknowledge that the population changed dramatically from 2000 to 2006, driven by the fact that the managed care organization stopped offering Medicare managed care in 2002. In our multivariable models, we adjusted for the major population differences in age, education, and comorbidities. We also conducted a sensitivity analysis for persons younger than 65 years and found that this did not change the estimates or P values (data not shown).

Because of the lack of a formal control group, we cannot say with certainty that the disease management program caused the observed changes. In addition, because the disease management program incorporated numerous interventions and was implemented over several years, we cannot quantify the effect of individual interventions on outcomes. It is

likely that some of the observed improvements in processes and outcomes of care were due to secular trend. The finding that continuous health plan enrollment was associated with improvement in some processes and outcomes of care and the degree to which outcomes improved make secular trend an unlikely explanation for all of our findings.

Acknowledgments

This study was jointly funded by Program Announcement 04005 from the Centers for Disease Control and Prevention (Division of Diabetes Translation) and the National Institute of Diabetes and Digestive and Kidney Diseases. The conclusions of this study are those of the authors and do not necessarily represent the views of the funding organizations. Members of the Translating Research Into Action for Diabetes (TRIAD) Study Group contributed to this study. The authors gratefully acknowledge the contribution of our health plan partner.

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Funding Source: This study was jointly funded by Program Announcement 04005 from the Centers for Disease Control and Prevention (Division of Diabetes Translation) and the National Institute of Diabetes and Digestive and Kidney Diseases.

Author Disclosures: The authors (LNM, VCH, EMN-K, GJK, KGS, WHH) report no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article.

Authorship Information: Concept and design (EMN-K, GJK, KGS, WHH); acquisition of data (EMN-K, WHH); analysis and interpretation of data (LNM, VCH, WHH); drafting of the manuscript (LNM, VCH, GJK, KGS, WHH); critical revision of the manuscript for important intellectual content (LNM, VCH, WHH); statistical analysis (LNM); provision of study materials or patients (GJK, KGS, WHH); obtaining funding (WHH); administrative, technical, or logistic support (EMN-K, GJK, WHH); and supervision (EMN-K, WHH).

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