Impact of Disease Management on Utilization and Adherence With Drugs and Tests

The case of diabetes treatment in the Florida: A Healthy State (FAHS) program

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OBJECTIVE — The purpose of this study was to evaluate the effect of telephonic care management within a diabetes disease management program on adherence to treatment with hypoglycemic agents, ACE inhibitors (ACEIs), angiotensin receptor blockers (ARBs), statins, and recommended laboratory tests in a Medicaid population.

RESEARCH DESIGN AND METHODS — A total of 2,598 patients with diabetes enrolled for at least 2 years in Florida: A Healthy State (FAHS), a large Medicaid disease management program, who received individualized telephonic care management were selected if they were eligible for at least 12 months before and 12 months after beginning care management. Patients were matched one-to-one on all baseline characteristics to 2,598 control patients. The impact of care management on utilization and adherence rates for diabetes-related medications and tests was analyzed with the difference-in-difference estimator.

RESULTS — Changes in utilization were evaluated separately for those who were characterized as adherent to treatment at baseline ("users") and those who were not ("nonusers"). Both groups achieved significant improvement in adherence between baseline and follow-up. Nonusers increased their overall hypoglycemic use by 0.7 script ($P < 0.001$), by 0.7 script for ACEIs and statins (both $P < 0.001$), by 0.8 test for A1C ($P < 0.001$), and by 0.7 test for lipids ($P < 0.001$). Users increased hypoglycemic use by 1.5 scripts ($P < 0.001$) and insulin use by 0.9 script ($P < 0.001$).

CONCLUSIONS — The FAHS telephonic care management intervention effectively induced Medicaid patients with diabetes to begin treatment and improved adherence to oral hypoglycemic agents and recommended tests. It also substantially improved adherence among baseline insulin users.

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L ifelong treatment adherence and lifestyle modification are recognized as the most critical components of diabetes management. A number of randomized clinical trials provide evidence that medication adherence and adherence to recommended tests and services can effectively reduce complications and improve patient outcomes (1,2). Other studies have shown that adherence to medications, tests, and services is associated with decreased hospitalizations, complications, and costs among individuals with type 2 diabetes (3). Yet many patients fail to comply with recommended treatment guidelines (4,5). A recent meta-analysis suggested that mean adherence to treatment recommendations for patients with diabetes is only between 58 and 75% (6).

Patient-centered interventions, such as disease management programs, can be used to improve adherence. They have been implemented to educate the chronically ill and to facilitate the management of their diseases (7). Their primary purpose is to monitor adherence to evidence-based treatment recommendations and to support the self-management skills to achieve adherence (8). There is evidence that disease management can improve the short-term processes of care, including medication adherence (9) and regular A1C and lipid testing (10).

To our knowledge, there are few published studies that examined the association between disease management program participation and adherence to medications and preventive health protocols in a Medicaid population (10). Medicaid populations and specifically beneficiaries with chronic conditions often have unique health care needs. Most beneficiaries have multiple chronic physical and behavioral health conditions, often complicated by difficult socioeconomic stressors (11). Beneficiaries with chronic conditions use health care and health-related services more frequently. Their care is on average more costly than that for beneficiaries without chronic conditions (11). A decreased ability to obtain timely, appropriate care and maintain continuity (12,13) contribute to these trends.

In this analysis we used data from the Florida: A Healthy State (FAHS) disease management program to assess the impact of educating Medicaid beneficiaries about their chronic diseases and increasing their self-management abilities. We evaluated whether a guideline-driven comprehensive disease management program can improve the use of diabetes-related recommended tests, services, and medications among Medicaid Primary Care Case Management (PCCM) beneficiaries with diabetes.

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RESEARCH DESIGN AND METHODS

FAHS

In 2001, Florida's Agency for Health Care Administration (AHCA) and Pfizer partnered to create a statewide disease management program to address multiple chronic diseases. The duration of this program was more than 5 years, between July 2001 and December 2006. A detailed explanation of the program's design, intervention and methods, and operations has been published elsewhere (14). Initially designed as a 2-year pilot, FAHS provided education and support to PCCM Medicaid beneficiaries. This clinically and financially successful program was extended for 2 more years in 2003 and subsequently transitioned to a new phase in 2005, led by the state, with Pfizer providing technical and program support. Briefly, AHCA and Pfizer designed a telephonic disease management model that reinforced goals already established between the health professional and patient to prevent exacerbations of chronic illness, support lifestyle change, and reduce the financial burden that chronic illness places on Florida's Medicaid program. Only PCCM program participants with diabetes, heart failure, hypertension, or asthma were eligible for FAHS. AHCA identified these individuals and assigned a risk score (based on proprietary algorithms developed by outside vendors) reflecting clinical severity and the likelihood of incurring high medical costs. Note that these algorithms were based on claims only and were therefore not affected by changes in guidelines related to cholesterol or blood pressure levels. Moderate- and high-risk beneficiaries were recruited for telephonic care management. All beneficiaries, including those at low risk, received low-literacy health education mailings and had access to a 24-h nurse call center.

The comprehensive telephonic care management model used in FAHS was delivered by nurse care managers responsible for tailoring treatment plans to each patient (14). Care managers used a Web-based decision support application offering guideline-recommended treatments and screenings. Adherence to medications and staying current on all recommended tests and services were emphasized. Care managers influenced adherence in at least four ways. They encouraged patients to follow through on the provider's orders and helped patients problem solve adherence issues. Nurses contacted the provider's office directly with information that might result in a new medication or test order. They sent laboratory kits directly to the patients to ensure that the results were available. Care managers also had an indirect influence on adherence to guidelines by educating and empowering patients to partner with their providers.

Analysis population

This analysis was limited to patients with diabetes enrolled in FAHS. Over the 5-year life of the program, 24,979 (13%) program participants had diabetes. Of these individuals, 7,517 (30%) were of moderate or high risk. As such, they were eligible to participate in the telephonic care management component of the program. Patients could opt out of care management voluntarily. The final sample consisted of 2,598 individuals who did not decline care management and were enrolled in FAHS for at least 12 months before participating in care management and at least 12 months after initiating care management.

These 2,598 beneficiaries were matched 1-to-1 to a control group of moderate- to high-risk beneficiaries with diabetes who were never care managed in the program. Beneficiaries in both the treatment and control groups were continuously eligible for FAHS for at least 2 years. Among the treatment group, the index date was the day care management began. A random observation window of 2 years was used for those in the control group. For them, the index date was simply the midpoint of this 2-year interval. These 2 years could be any continuous period between January 2002 and December 2006.

Outcome measures

In this research we considered several types of outcome measures: changes in utilization and adherence with drugs recommended for diabetes treatment as well as changes in patterns of annual laboratory tests. Hypoglycemic agents (both insulin and oral antidiabetic drugs), statins, ACE inhibitors (ACEIs), and angiotensin receptor blockers (ARBs) were considered separately. Drug utilization and adher-

Table 1—*Sample characteristics at baseline: demographics, comorbidities, non–drug health care utilization*

	Group 1: care managed	Group 2: not care managed	*P* value*
Demographics			
Age (years)	52.8	51.1	<0.001
Sex (% female)	78.3	70.0	<0.001
Medicaid eligibility under			
TANF	7.8	14.6	<0.001
SSI	86.8	80.0	<0.001
Both TANF and SSI	5.4	5.4	0.951
Race (%)			
Black	25.8	24.2	0.189
Hispanic	5.7	5.7	0.905
White	35.5	38.1	0.066
Other	32.9	32.1	0.534
Comorbidities			
Hypertension diagnosis (%)	16.7	11.4	<0.001
Dyslipidemia diagnosis (%)	5.7	4.5	0.059
Sum Charlson index conditions	0.6	0.4	<0.001
Myocardial infarction (%)	0.6	0.3	0.101
Congestive heart failure (%)	2.8	0.8	<0.001
Peripheral vascular (%)	1.2	0.6	0.020
Non–drug health care utilization			
No. emergency room visits	1.4	1.3	0.474
No. inpatient stays	0.4	0.4	0.543
No. outpatient visits	10.8	9.3	<0.001
No. other services	32.6	30.7	0.086

*χ^2 test or Student's *t* test. SSI, Supplemental Security Income; TANF, Temporary Aid to Needy Families.

ence measures were constructed for five classes of hypoglycemic agents (biguanides, sulfonylureas, thiazolidinediones, meglitinides, and insulin) and also for statins, ACEIs, and ARBs. Drug utilization was measured as the sum of days supplied with a refill in a particular drug class over a period of 1 year pre- and post-index. Adherence was measured with the medication possession ratio (MPR) (15). The MPR was calculated as the sum of days supplied, by class, over a 1-year period divided by 365. The computation of an MPR for overall hypoglycemic treatment, including the combination of hypoglycemic agents, was more complex. We assumed that a prescription for a different class of agents represented a switch to a new class if the new prescription was filled >90 days after that for the previous drug. If the interval was shorter, the patient was assumed to be taking two drugs simultaneously, and MPRs were averaged. MPRs were simply added to each other. Recommended laboratory tests and screening procedures (16,17) were also evaluated. Laboratory codes were used to identify A1C, lipid profile, and microalbumin tests, and retinal examinations were identified with CPT codes. Their utilization was measured as a count of the number of claims over 1 year.

Statistical analysis

To determine the impact of care management, patients who were care managed were compared with patients who were not in a case-control study. To ensure that both groups were similar, patients were matched pairwise with a minimum distance estimator (18). Matching was based on baseline characteristics including health care utilization (i.e., health services, laboratory, and pharmacy), comorbidity burden, age, sex, race, and Medicaid enrollment status (Supplemental Security Income or Temporary Assistance for Needy Families). Diagnoses were used as a proxy for severity of disease and were combined to create a Charlson comorbidity index (19). Patients in both groups had identical health care benefits and were treated over the same period of time, thus eliminating the impact of changes in the health care system, health care benefits, or treatment guidelines.

Our analysis proceeded in two steps. First, we compared key baseline characteristics (demographics, comorbidities, and health care utilization) and baseline use of glycemic control, antihypertensive,

Table 2—Baseline proportion of users, average utilization among users, average MPR among users, and proportion of users with MPR ≥80%

	Proportion of users (%)			Average utilization among users			Average MPR among users			Proportion users with MPR ≥80%		
	Care managed	Not care managed	P value*	Care managed	Not care managed	P value†	Care managed	Not care managed	P value†	Care managed	Not care managed	P value*
Hypoglycemic agent prescriptions												
All hypoglycemic agents	86.6	77.5	<0.001	13.2	14.1	<0.001	59.9	61.1	0.042	30.3	33.0	0.055
Biguanide (metformin)	41.6	34.9	<0.001	6.7	6.8	0.561	54.1	55.2	0.478	31.0	32.6	0.450
Meglitinide	3.0	2.9	0.742	4.4	4.7	0.643	35.8	37.9	0.663	14.1	14.1	0.716
Sulfonylurea	48.0	42.5	<0.001	8.0	7.9	0.811	64.3	63.8	0.646	43.1	43.1	0.800
Thiazolidinedione	30.5	29.4	0.348	6.7	6.9	0.559	55.0	56.0	0.566	33.3	33.3	0.860
Insulin	30.6	28.5	0.088	9.2	10.0	0.020	60.2	63.0	0.073	36.1	39.4	0.191
Cardiovascular medication prescriptions												
ACEI	48.6	33.1	<0.001	7.4	7.5	0.752	60.6	60.3	0.860	41.3	39.7	0.435
ARB	14.8	10.9	<0.001	7.1	7.3	0.498	58.2	59.6	0.555	36.7	37.4	0.834
Statin	46.7	33.5	<0.001	6.8	6.9	0.934	56.2	55.6	0.645	32.7	30.4	0.231
Laboratory test												
A1C	67.5	61.8	<0.001	2.1	2.0	0.271						
Lipid	66.2	61.4	<0.001	1.9	1.8	0.0193						
Microalbumin	15.4	15.3	0.847	1.3	1.2	0.086						
Retinal examinations	45.8	37.1	<0.001	1.7	1.7	0.964						

The number of patients in each category can be derived from the total sample size multiplied by the proportion of users. Users are patients who filled one or more prescriptions in the drug class considered in each line or received one ore more laboratory tests. *χ^2 test. †Student's t test.

Table 3—Hypoglycemic and cardiovascular drugs: changes in utilization and adherence

	Nonusers at baseline		Users at baseline only	
	Care managed vs. not care managed	*P* value	Care managed vs. not care managed	*P* value
Number of fills*				
Hypoglycemic drug prescriptions				
All hypoglycemic agents	0.7	0.041	1.5	<0.001
Biguanide (metformin)	0.5	<0.001	0.1	0.548
Meglitinide	0.03	0.061	0.2	0.754
Sulfonylurea	0.6	<0.001	0.3	0.02
Thiazolidinedione	0.2	0.005	0.3	0.109
Insulin	0.1	0.214	0.9	<0.001
Cardiovascular medication prescriptions				
ACEI	0.7	<0.001	0.3	0.02
ARB	0.2	<0.001	0.4	0.107
Statin	0.7	<0.001	0.06	0.676
Days supply*				
Hypoglycemic drug prescriptions				
All hypoglycemic agents	17.3	0.064	47.0	<0.001
Biguanide (metformin)	14.6	<0.001	3.4	0.439
Meglitinide	1.1	0.037	5.9	0.727
Sulfonylurea	17.9	<0.001	11.1	0.009
Thiazolidinedione	6.7	0.005	8.9	0.104
Insulin	0.2	0.918	34.0	<0.001
Cardiovascular medication prescriptions				
ACEI	22.3	<0.001	9.9	0.018
ARB	5.7	<0.001	11.0	0.102
Statin	19.2	<0.001	1.8	0.646
MPR (% days covered)				
Hypoglycemic drug prescriptions				
All hypoglycemic agents	8.7	<0.001	6.9	<0.001
Biguanide (metformin)	4.5	<0.001	−0.4	0.740
Meglitinide	0.3	0.014	0.2	0.968
Sulfonylurea	5.7	<0.001	1.3	0.231
Thiazolidinedione	2.4	<0.001	1.0	0.488
Insulin	1.3	0.004	5.7	<0.001
Cardiovascular medication prescriptions				
ACEI	6.2	<0.001	4.3	0.685
ARB	1.3	0.001	0.7	0.7003
Statin	5.4	<0.001	−2.0	0.064

The difference-in-differences estimator was used here. Results are expressed as the change in utilization or MPR in the care-managed group relative to the not–care managed group. *Over a 12-month period.

and antidyslipidemia agents and recommended annual diabetes-related tests. The second step evaluated changes over time in two categories of patients: those who reported using diabetes-related medications or tests at baseline (users) and those who reported not using such drugs or tests at baseline (nonusers). Users were defined for each drug class (e.g., insulin, thiazolidinediones, and statins) as patients who filled at least one prescription at baseline. Nonusers were patients who did not fill any prescription in the drug class considered. For tests, users were defined as patients who received a least one test at baseline. Changes in utilization and adherence were calculated as the difference between year 2 (follow-up) and year 1 (baseline) values. We compared the changes in those care managed versus those not care managed with the difference-in-differences estimator (20).

RESULTS —At baseline, care-managed patients, although similar to never care-managed patients (Table 1), were slightly older (52.8 vs. 51.1 years; $P < 0.001$), more likely to be female (78.3 vs. 70.0%; $P < 0.001$), and more likely to be eligible for Medicaid as Supplemental Security Income beneficiaries (86.8 vs. 80.0%; $P < 0.001$). More care-managed patients received a diagnosis of hypertension, congestive heart failure, or peripheral artery disease and had slightly higher comorbidity scores. These differences as well as differences in race and most nondrug utilization were small, although sometimes statistically significant, and were controlled for in our model.

Table 2 shows baseline values for drug and laboratory test utilization (proportion of users and average utilization among users) and adherence with drug treatment (as average MPR among users and proportion of users with MPR ≥80%). Care-managed patients were more likely to have used a hypoglycemic agent, an ACEI, an ARB, or a statin at baseline, although average utilization and adherence were not significantly different between groups. The same pattern occurred with annual laboratory test utilization.

In the explanatory analysis, we quantified improvements in utilization and adherence with drug treatments separately for baseline nonusers and users (Table 3). It is important to realize that in this table the impact of care management is measured by the change in utilization for patients receiving treatment relative to control subjects—not relative to baseline (group-specific values are available from the authors). Care-managed patients reporting no utilization at baseline (nonusers) were more likely to fill prescriptions, to maintain more days of supply, and to have higher MPR than patients who were not care managed. Care-managed patients filled an average of 0.7 script for hypoglycemic agents ($P = 0.041$), 0.7 script for ACEIs ($P < 0.001$), and 0.7 script for statins ($P < 0.001$) more than non–care-managed patients. The increase in days of supply and adherence paralleled the rise in number of prescriptions filled.

Care-managed patients reporting some baseline utilization (users) achieved a significant increase in the number of fills and days' supply of insulin, sulfonylurea, and ACEI. There was also a significant increase in MPR, with the increase concentrated in the insulin class. Compared with baseline nonusers, who increased by only a small amount of refill and days' supply (0.1 fill and 0.2 days' supply) and achieved a modest (1.3%) increase in

Table 4—*Laboratory tests: changes in utilization*

	n*	Care managed vs. not care managed†	P value
Patients with 0 tests at baseline			
A1C	844	0.75	<0.001
Lipid panel	879	0.67	<0.001
Microalbumin test	2,196	0.14	<0.001
Retinal examinations	1,407	0.54	<0.001
Patients with 1 test at baseline			
A1C	686	0.42	<0.001
Lipid panel	754	0.33	<0.001
Microalbumin test	317	−0.47	<0.001
Retinal examinations	785	−0.23	<0.001
Patients with 2 tests at baseline			
A1C	566	−0.24	0.012
Lipid panel	536	−0.40	0.003
Microalbumin test	68	−1.18	<0.001
Retinal examinations	224	−0.41	<0.001
Patients with ≥3 tests at baseline			
A1C	501	−0.96	<0.001
Lipid panel	428	−1.04	<0.001
Microalbumin test	16	−2.00	<0.001
Retinal examinations	181	−1.92	<0.001

The difference-in-differences estimator was used here. Results are expressed as the change in utilization or MPR in the care-managed group relative to the not–care managed group. *Number of care-managed patients. †Number of tests received over 12 months.

MPR, baseline users added significantly to their regimen (0.9 script and 34.0 days' supply), resulting in a 5.7% increase in MPR.

Next, we determined the impact of care management on recommended laboratory tests and retinal examinations (Table 4). This analysis was also divided according to baseline utilization. Comparisons are presented for nonusers at baseline and for baseline users with one test, two tests, or three or more tests within the 12 months before the initiation of the program. Care-managed patients with no tests at baseline experienced a significant increase in the number of A1C, lipid, and microalbuminuria tests and retinal examinations performed (0.75 for A1C, 0.67 for lipid, 0.14 for microalbumin, and 0.54 for retinal examination; all with $P < 0.001$). The pattern was more complex among baseline users. The general pattern that emerged was that care-managed baseline users with one test at baseline experienced increases in A1C and lipid testing compared with baseline users who were not care managed. Conversely, care-managed baseline users with more than two tests experienced significant decreases in test utilization compared with baseline users who were not care managed.

CONCLUSIONS — Many chronically ill individuals fail to adhere to recommended medication and testing regimens. This article demonstrates that, among patients with diabetes, telephonic disease management improved adherence to both. Although there have been studies of type 2 diabetes that have addressed adherence to hypoglycemic medications (21) and studies that have looked at adherence to recommended tests and screenings (22,23), this study is unique in that it looked at both to create a broader view of treatment adherence. Another distinguishing feature of this study is that it is the first to our knowledge that evaluated the association between participation in telephonic disease management and treatment adherence among Medicaid beneficiaries with diabetes.

Our findings indicate that care-managed patients increased their drug utilization compared with matched control subjects. First, patients who filled no prescriptions for a hypoglycemic agent, an ACEI, an ARB, or a statin during the year before being care managed were more likely to initiate treatment. That is, they were more likely than patients who did not receive care management to fill at least one prescription. Second, even though care management increased the odds of initiating treatment among patients who had filled at least one prescription for a hypoglycemic agent, an ACEI, an ARB, or a statin in the year before, the number of prescriptions filled during the study period remained low on average. The notable exception to this pattern was insulin treatment. Insulin utilization and adherence increased significantly among baseline users. This result is particularly important, as it probably applies to patients who typically have more severe diabetes.

Care management also affected receipt of laboratory tests and screenings. Patients who had no test at baseline were more likely to have at least one test performed during the follow-up period. In contrast, compared with non–care-managed patients, care-managed patients who had two or more tests at baseline had fewer tests performed during follow-up. This may indicate that baseline test users received unnecessary tests at baseline and that care management reduced the use of unnecessary services.

The analysis also has limitations. First, assignment to treatment and control groups was not random, and beneficiaries were allowed to opt out of the program. Although differences in baseline values between members of the treatment and control groups were small, these differences could, in principle, bias our estimates. However, as we relied on a difference-in-differences estimator, it is the change in the values of predictors and outcomes that matters. The key issue is whether there is any evidence that disease and utilization trajectories over time among the treatment group would have been different from those of control subjects in the absence of treatment. Careful review of baseline values indicated that observed differences between groups were not large enough to suggest different disease progression trajectories and are therefore unlikely to have introduced significant bias. Second, there is a certain degree of imprecision regarding diagnoses in claims data, as physicians rarely record the full five digits of diabetes diagnoses, and we could not perform a separate analysis on type 1 and type 2 diabetic patients to determine whether the observed increase in adherence to insulin among baseline users might be attributable to one of these groups.

A key question given the exclusion criteria used to create our sample is whether our results can be generalized to all diabetic patients in this Medicaid pop-

ulation. A comparison of the final sample of patients ($n = 2,598$) with patients we excluded from analysis showed little difference in demographic characteristics and health care utilization (available from authors), and our results should therefore be generalizable.

In summary, the results reported here are important because adherence to recommended medication and testing regimens can decrease micro- and macrovascular complications (2) and elevated A1C and LDL levels (3,24), lower hospitalization rates (25) and health care costs (6), and decrease cardiovascular disease–related deaths (5). This study provides evidence that care management can be effective in encouraging patients to use hypoglycemic and cardiovascular medications as prescribed and in teaching patients to seek recommended laboratory tests and retinal eye examinations appropriately. It is also important to note that FAHS was designed for a particularly difficult-to-reach chronically ill population that accounts for a significant share of Florida's Medicaid expenditures and that even in populations with such complex conditions telephonic care management can be effective in changing behaviors.

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