

Impact of Primary Care Intensive Management on Medication Adherence and Adjustments

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Many health care systems are developing new models of care to target patients at high risk for poor outcomes and high health care costs.¹⁻⁴ These patients often have multiple chronic conditions, behavioral health conditions, and social issues,^{5,6} so traditional care models may not be sufficient to address all their needs. Intensive management in primary care through interdisciplinary teams and case management is a new type of model that targets high-risk patients.⁷ Evidence from these types of programs has shown increased utilization of primary care and other outpatient care but little change in inpatient care or total health care costs.^{7,8} Little is known about the effect of these programs on medication adherence or adjustments.

Primary care intensive management (PIM) was piloted in the Veterans Health Administration (VHA) beginning in 2014 to improve management of patients at high risk for hospitalization. These patients often had multimorbid conditions and were prescribed multiple medications for chronic conditions.⁹ In the PIM program, interdisciplinary care teams assisted with medication management and provided services such as medication reconciliation, assistance with refills, education about medications, and coaching to improve medication adherence.¹⁰ These services addressed common issues among older adults with multimorbid conditions, including polypharmacy and low adherence.¹¹⁻¹³ Furthermore, these services may fill a gap in care because physicians do not typically have time to conduct thorough medication reviews and adherence assessments to identify medication management problems.¹⁴ Also, patients may not receive optimal doses or quantities of drugs¹⁵ or may have difficulty managing multiple medications and may benefit from simplified regimens.^{16,17}

Although PIM programs were primarily intended to improve management of high-risk patients and reduce unnecessary acute care utilization, they may also have affected medication adherence and medication adjustments. Medication adjustments for patients managing multiple prescriptions can be considered markers of patient-centered prescribing and are considered modifiable provider behavior, similar to adherence.^{18,19} We examined the impact of PIM on adherence to medications and medication adjustments,

ABSTRACT

OBJECTIVES: The Veterans Health Administration implemented a pilot program for primary care intensive management (PIM) for patients at high risk for hospitalization. We examined the impact of the program on medication adherence and adjustments for patients with chronic conditions.

STUDY DESIGN: A randomized quality improvement trial was conducted in 5 sites in which high-risk patients were randomized into PIM or usual primary care; outcomes were measured in the 12 months before and after randomization. Interdisciplinary PIM teams assessed patients for unmet needs and offered services including pharmaceutical care and care coordination.

METHODS: Outcomes included adherence, measured by proportion of days covered, and several measures of medication adjustments for diabetes, depression, hyperlipidemia, and hypertension medications. Differences-in-differences methods were used to estimate changes in outcomes between PIM and usual care groups.

RESULTS: There were 1527 patients in the medication adherence cohort and 1719 in the medication adjustments cohort. Mean adherence was mostly similar between groups but 16% higher among PIM patients for dipeptidyl-peptidase-4 (DPP-4) inhibitors (for diabetes) after randomization (0.12 vs -0.04; $P = .02$). The mean number of hyperlipidemia drugs filled was higher among PIM patients (1.1 vs 1.0; $P = .006$). The mean number of discontinued depression medications was higher and the mean number of dose changes for hypertension medications was lower for PIM patients, although these comparisons did not reach statistical significance.

CONCLUSIONS: Medication adherence improved for DPP-4 inhibitors, and more hyperlipidemia drugs were prescribed for PIM patients. Overall impacts of PIM were modest.

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TAKEAWAY POINTS

- ▶ A pilot program for primary care intensive management enrolled patients at high risk for hospitalization in 5 Veterans Health Administration sites. These programs all included pharmaceutical care.
- ▶ Twelve months after patients were randomly assigned to the program or usual primary care, most medication adherence and adjustments outcomes were similar.
- ▶ For patients randomized to the program, medication adherence improved for dipeptidyl-peptidase-4 inhibitors, and more hyperlipidemia drugs were prescribed.
- ▶ Although impacts were modest, intensive management teams appear to have contributed to medication management for diabetes and hyperlipidemia.

including changes in number of drugs filled, switches between drug classes, added or discontinued prescriptions, and dose changes. We compared these outcomes for diabetes, depression, hypertension, and hyperlipidemia drugs among patients randomly assigned to PIM and usual primary care after 12 months of program enrollment.

METHODS

PIM Program and Study Population

The VHA piloted the PIM program at 5 sites to develop and test intensive outpatient management programs. The evaluation was designed as a randomized quality improvement trial in which patients in the top 10% of risk for 90-day hospitalizations²⁰ and with at least 1 hospitalization or emergency department (ED) visit in the prior 6 months were randomized into PIM or usual primary care.⁹ Details on the overall study design and intervention were described previously.^{8,9}

Briefly, an interdisciplinary team composed of primary care providers, registered nurses, social workers, licensed vocational nurses or peers, and mental health specialists at each site performed chart reviews and in-person visits to assess patients randomized to PIM. PIM was designed so that patients who were thought to benefit immediately from PIM services received these services in addition to usual primary care whereas patients not thought to benefit from immediate services were monitored through their electronic health record. Patients assigned to usual primary care did not receive any additional care. Usual primary care was delivered through the VHA patient-centered medical home model, called Patient Aligned Care Teams (PACT), in which pharmacists were integrated into primary care teams; we refer to patients assigned to usual primary care as the PACT group.

To analyze our 2 sets of outcomes for medication adherence outcomes and medication adjustments outcomes, we used 2 study cohorts. Patients randomized to PIM or PACT from July 21, 2014, to August 28, 2015, who had at least 1 diagnosis for diabetes, depression, hypertension, or hyperlipidemia and VHA prescription records for medications to treat these conditions (**eAppendix** [available at ajmc.com]) were included in our analysis for medication adjustments. For the medication adherence analysis, we imposed an additional restriction to include only patients who filled drugs in both the pre- and postrandomization periods, to avoid counting patients

who discontinued prescriptions appropriately as nonadherent.

DATA SOURCES

Data were from the VHA Corporate Data Warehouse (CDW) and included prescription drug records from the Managerial Cost Accounting Prescription Drug Files for fiscal years 2013-2016. Other CDW data included inpatient and outpatient utilization, diagnosis, and patient characteristics.

Dependent Variables

Our dependent variables included outcomes for medication adherence and medication adjustments and were measured for 2 separate cohorts. For both sets of outcomes, we measured medication outcomes in the 12-month periods before and after randomization to PIM or PACT and limited drugs to those that were noninjectable.

Our first set of outcomes involved medication adherence. Adherence has been previously conceptualized as having 3 components: initiation of treatment, when the first dose of a medication is taken; implementation of dosing regimen, for the period where a patient's dosing may or may not correspond to the prescribed dosing; and discontinuation, when a treatment ends.²¹ We focused on measuring adherence in the implementation phase, and it was measured by proportion of days covered (PDC) for each unique drug filled, based on prescription drug refill records.²²⁻²⁴ The numerator for the PDC was the number of days covered by the patients' prescription fills, and the denominator was the number of days between the first fill and last day of the observation period, within each pre- and postrandomization period. If patients filled drugs for more than 1 drug in a class, the PDCs for the drugs were averaged to obtain a mean PDC for the drug class. The PDC excluded the hospitalization period for patients with any hospitalization. We obtained the mean PDC for each patient for all drugs filled for each study condition (diabetes, depression, hypertension, and hyperlipidemia).

Our second set of outcomes involved adjustments made to patients' medication regimens. We created several measures of medication adjustments that occurred between the pre- and postrandomization periods: (1) change in total number of unique drugs filled, (2) switches between drug classes, (3) added prescriptions, (4) discontinued prescriptions, and (5) dose changes.^{18,25} To measure the change in total number of medications, we took the difference between the number of unique drugs that each patient filled in the 12-month pre- and postrandomization periods for any prescription for the study conditions. To count switches between drug classes, we compared unique drug classes filled for each patient in the pre- and postrandomization periods to see if any switches occurred. For added prescriptions, we counted the number of drugs filled in the postrandomization period but not in the prerandomization period. For discontinued prescriptions,

we counted the number of drugs filled in the prerandomization period but not in the postrandomization period. For dose changes, we established an index fill for the last fill for a unique drug that occurred in the 12-month prerandomization period, and we compared all subsequent prescription records during the postrandomization period to see if any of these fills had a different dose than the index fill. We then calculated the number of medication adjustments per patient per condition.

Independent Variables

For descriptive purposes and regression adjustment, we measured several patient characteristics: age, gender, race/ethnicity, marital status, VHA enrollment priority, common chronic conditions (cancer, heart failure, diabetes, hypertension, ischemic heart disease, renal failure, hyperlipidemia, lower back pain, arthritis, chronic obstructive pulmonary disorder, vision impairment, dementia, alcohol use disorders, depression, drug use disorders, posttraumatic stress disorder, manic depression, and schizophrenia), Charlson Comorbidity Index (CCI) score, and site. Categories used for VHA enrollment priority, which takes into account service-connected disability and household income, included 1 to 3 for high priority, 4 to 6 for medium priority, and 7 or 8 for low priority. We also obtained the mean number of primary care visits in the 12-month period after randomization, including PIM visits.

Analysis

After excluding patients who died during the 12-month follow-up period ($n = 65$), all other patients were analyzed based on treatment group assignment. We compared unadjusted outcomes by time period (pre- or post randomization) and study group (PIM or usual PACT care) for each condition. SAS (SAS Institute) was used to conduct unadjusted analyses.

In adjusted analysis, we used differences-in-differences (DID) methods to estimate the change in adherence for the PIM group relative to the PACT group from the pre- to the postrandomization period. We used fractional logit models²⁶ with covariates for group assignment, time period, interaction between group and time period, age, gender, CCI score, presence of mental health or substance use conditions, and site. Standard errors were adjusted for clustering within patients. We estimated separate models by drug class and by condition.

Numbers of total medications were compared in adjusted analysis in separate models for each condition using DID methods and generalized linear models. These models included the same covariates as adherence models. The other medication adjustment measures (switches between drug class, added medications, discontinued medications, and changes in dose) were analyzed using generalized linear models with the appropriate family and link function based on the modified Park test.²⁷ We used a statistical significance level of 0.05 that was adjusted for comparing 5 different measures of medication adjustments simultaneously (Bonferroni-adjusted significance level of 0.01). Stata (StataCorp) was used to conduct all regression analyses.

RESULTS

There were 1527 patients in the medication adherence cohort and 1719 in the medication adjustments cohort. Patient characteristics were similar across the PIM and PACT groups (Table 1). The mean age ranged from 62 to 64 years, about half of patients were white, and the vast majority were male. A minority of patients were currently married, many had high priority for VHA care, and the mean CCI score was 1.4 in both groups. The most common study condition was hypertension (75%-82%), followed by hyperlipidemia (43%-47%). After randomization, patients assigned to PIM had a mean of 6.1 to 6.2 primary care visits compared with 4.4 to 4.6 among PACT patients.

Unadjusted mean medication adherence for the study conditions (Figure) was similar between care groups, ranging from 77% to 93% across drug classes. In adjusted analysis, there was a 12% increase (79% to 91%) in predicted mean adherence to dipeptidyl-peptidase-4 (DPP-4) inhibitors for diabetes in PIM patients between pre- and post randomization. PACT patients had a 4% decrease (71% to 67%) in predicted mean adherence to DPP-4 inhibitors over the same time period. The DID estimate was 16% ($P = .02$) (Table 2). There were no significant differences in adherence for all other drug classes between the care groups.

The total mean number of drugs filled for PIM and PACT patients was similar at baseline for most conditions (Table 3). However, the PIM group had a significantly higher mean number of hyperlipidemia drugs at study end (1.1 and 1.0, respectively; $P = .006$) due to a greater mean number of prescriptions added in the postrandomization period (0.19 and 0.13 for PIM and PACT, respectively; $P = .033$). The 2 care groups had a similar mean number of switches across drug classes. PIM patients had a higher (nonsignificant at Bonferroni-adjusted significance level of 0.01) mean number of discontinued prescriptions for depression (0.63 and 0.51 for PIM and PACT, respectively; $P = .045$). There were more (nonsignificant) mean dose changes for hypertension among PACT patients (0.31 and 0.25 for PACT and PIM, respectively; $P = .032$).

DISCUSSION

We found that high-risk patients assigned to an intensive primary care program had similar medication adherence to patients in usual primary care, with the exception of a significant increase in adherence for DPP-4 inhibitors. DPP-4 inhibitors are used to treat patients who have not responded to other diabetes drugs or have experienced hypoglycemic events with formulary medications; this suggests that PIM teams were more involved than PACT teams in the care of patients facing greater challenges to routine diabetes management. Patients assigned to the intervention group did not experience significant increases in adherence to any of the other drugs in the study, possibly because mean refill adherence was relatively high at baseline for all of the drugs studied. Factors such as high tolerability may help to explain high baseline adherence.^{28,29} Also, VHA charges low cost-sharing amounts for prescriptions and

TABLE 1. Patient Characteristics of Study Cohorts^a

Patient characteristics	Medication adherence cohort ^b		Medication adjustments cohort ^b	
	PACT ^c (n = 752)	PIM ^d (n = 775)	PACT ^c (n = 863)	PIM ^d (n = 856)
	Mean (SD) or n (%)		Mean (SD) or n (%)	
Age in years, mean (SD)	63 (12)	64 (11)	62 (12)	63 (11)
Race/ethnicity, n (%)				
White	349 (47)	385 (50)	393 (46)	413 (49)
Black	346 (47)	331 (43)	400 (47)	380 (45)
Hispanic	19 (3)	21 (3)	24 (3)	23 (3)
Other	29 (4)	31 (4)	33 (4)	32 (4)
Gender, n (%)				
Male	672 (89)	702 (91)	769 (89)	772 (90)
Female	81 (11)	73 (9)	94 (11)	84 (10)
Marital status, n (%)				
Married	256 (34)	288 (37)*	290 (34)	305 (36)
Single	152 (20)	118 (15)	189 (22)	131 (15)
Divorced/separated/widowed	344 (46)	368 (48)	383 (44)	419 (49)
VHA enrollment priority, n (%)				
1-3	442 (59)	443 (57)	494 (57)	493 (58)
4-6	252 (33)	259 (33)	299 (35)	284 (33)
7-8	59 (8)	73 (9)	70 (8)	79 (9)
Site, n (%)				
Site 1	146 (19)	147 (19)	171 (20)	167 (20)
Site 2	142 (19)	147 (19)	160 (19)	162 (19)
Site 3	198 (26)	202 (26)	221 (26)	218 (25)
Site 4	124 (16)	136 (18)	153 (18)	155 (18)
Site 5	143 (19)	143 (18)	158 (18)	154 (18)
CCI score, mean (SD)	1.4 (0.80)	1.4 (0.78)	1.4 (0.82)	1.4 (0.80)
Number of chronic conditions, ^f mean (SD)	6.7 (3.2)	6.8 (2.8)	6.5 (3.2)	6.7 (2.8)
Filled prescriptions for study condition, n (%)				
Hypertension	595 (78)	633 (82)	651 (75)	702 (82)
Hyperlipidemia	325 (43)	367 (47)	372 (43)	389 (45)
Depression	269 (36)	256 (33)	387 (45)	379 (44)
Diabetes ^g	186 (25)	176 (23)	375 (43)	374 (44)
Number of primary care visits (including PIM visits), mean (SD)	4.6 (4.4)	6.2 (8.0)	4.4 (4.2)	6.1 (7.7)

CCI, Charlson Comorbidity Index; PACT, Patient Aligned Care Team; PIM, primary care intensive management; VHA, Veterans Health Administration.

^aPatient characteristics were measured in the 12-month period prior to randomization, except for primary care visits, which were measured in the 12-month period after randomization.

^bPatients who had prescription fills for the study drugs in both the pre- and postrandomization periods were included in the adherence analyses. Patients who had prescription fills in either the pre- or postrandomization period for the study drugs were included in the adjustments analyses.

^cPACT refers to patients assigned to usual primary care through the VHA's patient-centered medical home model, called Patient Aligned Care Team.

^dPIM refers to the intervention group, called the primary care intensive management group.

^eSignificantly different between PIM and PACT at $P < .05$.

^fA total of 18 chronic conditions were measured.

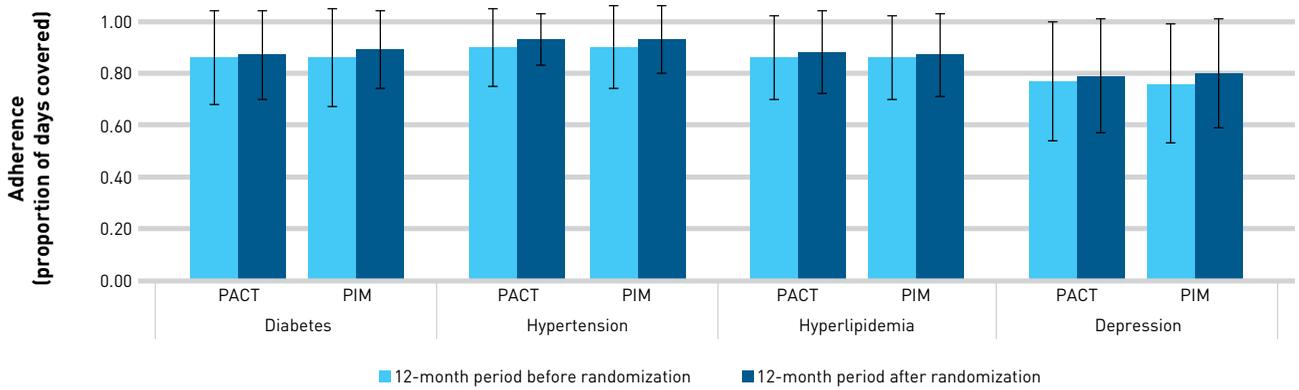
^gExcludes insulin and other injectable drugs.

provides streamlined procedures for patients to refill prescriptions through mail ordering and automatic reminders to providers to reorder prescriptions, so refilling prescriptions may not have been a problem for many patients in the study. However, it is unknown to what extent patients actually took their medications as prescribed and whether there were differences by treatment group.

We found few significant results comparing measures of medication adjustments among the intervention and usual care patients. Intervention patients filled significantly more additional prescriptions and more total prescriptions to treat hyperlipidemia. Intervention patients had slightly more discontinuations for antidepressants and fewer dose changes for antihypertensive medications compared with usual care patients, although these differences did not reach statistical significance. More prescriptions to treat hyperlipidemia for intervention patients suggests more aggressive management of hyperlipidemia through medications, so PIM teams may have identified underuse of these drugs and helped to increase their use. For discontinuations of antidepressants, some may have been warranted, such as when patients did not need continued treatment when a depression episode ended or when the medication regimen was simplified. It is unclear from our data whether the antidepressant discontinuations we observed among the PIM patients were appropriate. It is also unknown why PIM patients experienced fewer dose changes for hypertension drugs and how PIM teams may have affected this.

Although studies of similar intensive outpatient management programs with interdisciplinary teams have focused on outcomes such as health care costs and hospital and ED utilization,³⁰⁻³² our study is among the first to examine impacts on outcomes related to medication management. We found far fewer significant intervention effects on medication adjustments than a previous randomized trial of collaborative care management for complex patients, which found a large impact on increasing adjustments to medications for antidepressants, insulin, and antihypertensives, along with improved condition control.¹⁹ Unlike the collaborative care management trial, which targeted patients who had poorly

FIGURE. Unadjusted Mean Medication Adherence^a for Patients in PACT^b and PIM^c (n = 1527)



PACT, Patient Aligned Care Team; PIM, primary care intensive management; VHA, Veterans Health Administration.

^aMedication adherence was measured by the proportion of days covered. Bars represent standard errors of mean adherence.

^bPACT refers to patients assigned to usual primary care through the VHA's patient-centered medical home model, called Patient Aligned Care Team.

^cPIM refers to the intervention group, called the primary care intensive management group.

TABLE 2. Predicted Mean Medication Adherence^a Before and After Randomization to Study Group (n = 1527)

Medication type	Mean adherence, in proportion of days covered [95% CI]				DID estimate
	PACT ^b		PIM ^c		
	Prerandomization	Post randomization	Prerandomization	Post randomization	
Diabetes ^d	0.85 (0.83-0.88)	0.85 (0.82-0.87)	0.85 (0.82-0.88)	0.87 (0.85-0.90)	0.03 [-0.01 to 0.07]
Biguanides	0.80 (0.77-0.83)	0.80 (0.78-0.83)	0.82 (0.79-0.86)	0.83 (0.80-0.86)	-0.00 [-0.06 to 0.05]
Sulfonylureas	0.79 (0.75-0.83)	0.81 (0.77-0.86)	0.80 (0.76-0.84)	0.80 (0.76-0.84)	-0.02 [-0.10 to 0.06]
DPP-4 inhibitors	0.71 (0.58-0.83)	0.67 (0.49-0.84)	0.79 (0.71-0.86)	0.91 (0.85-0.98)	0.17 (0.01-0.34) ^e
Hypertension	0.90 (0.89-0.91)	0.93 (0.92-0.94)	0.89 (0.88-0.91)	0.92 (0.91-0.93)	-0.00 [-0.02 to 0.01]
ACE inhibitors	0.73 (0.70-0.76)	0.83 (0.81-0.85)	0.75 (0.72-0.78)	0.83 (0.81-0.85)	-0.01 [-0.10 to 0.04]
Adrenergic blockers	0.74 (0.68-0.80)	0.72 (0.65-0.79)	0.77 (0.71-0.83)	0.78 (0.73-0.83)	0.03 [-0.10 to 0.14]
Angiotensin receptor blockers	0.82 (0.78-0.86)	0.83 (0.80-0.87)	0.83 (0.79-0.87)	0.85 (0.82-0.89)	0.01 [-0.05 to 0.07]
β-blockers	0.80 (0.78-0.82)	0.84 (0.82-0.86)	0.82 (0.80-0.84)	0.85 (0.83-0.84)	-0.01 [-0.05 to 0.03]
Calcium channel blockers	0.80 (0.78-0.83)	0.82 (0.80-0.85)	0.81 (0.78-0.83)	0.81 (0.78-0.83)	-0.02 [-0.07 to 0.02]
Diuretics	0.67 (0.65-0.70)	0.87 (0.84-0.89)	0.73 (0.71-0.76)	0.86 (0.83-0.89)	-0.07 [-0.12 to -0.02]
Hyperlipidemia	0.86 (0.84-0.87)	0.86 (0.84-0.88)	0.85 (0.83-0.87)	0.86 (0.85-0.88)	0.01 [-0.01 to 0.04]
Antidepressants	0.75 (0.72-0.78)	0.76 (0.73-0.78)	0.74 (0.71-0.77)	0.77 (0.75-0.80)	0.03 [-0.01 to 0.07]
SSRIs	0.66 (0.63-0.70)	0.66 (0.62-0.70)	0.67 (0.63-0.71)	0.71 (0.67-0.75)	0.04 [-0.02 to 0.11]
Other antidepressants	0.72 (0.69-0.75)	0.73 (0.70-0.76)	0.68 (0.64-0.71)	0.68 (0.65-0.71)	-0.01 [-0.06 to 0.05]

ACE, angiotensin-converting enzyme; DID, differences-in-differences; DPP-4, dipeptidyl-peptidase-4; PACT, Patient Aligned Care Team; PIM, primary care intensive management; SSRI, selective serotonin reuptake inhibitor; VHA, Veterans Health Administration.

^aMedication adherence was measured by the proportion of days covered. Predicted mean adherence was estimated from fractional logit models based on generalized linear models with a binomial family and logit link function. Covariates included for PIM, postrandomization, interaction between PIM and postrandomization, age, gender, marital status, Charlson Comorbidity Index score, presence of mental health or substance use conditions, and site.

^bPACT refers to patients assigned to usual primary care through the VHA's patient-centered medical home model, called Patient Aligned Care Team.

^cPIM refers to the intervention group, called the primary care intensive management group.

^dInsulin adherence not measured.

^eSignificant at $P < .05$.

controlled conditions and excluded patients receiving psychiatric care and certain psychiatric diagnoses, our study population was heterogeneous, and many had diagnoses of depression and other psychiatric conditions. Because mental health problems can

complicate chronic condition management for patients,^{33,34} it is unsurprising that patients in our study had fewer improvements in medication management. Moreover, many patients randomized to PIM received few or no visits with the PIM team because some

TABLE 3. Medication Adjustments Made in the Postrandomization Period (n = 1719)^a

Medication adjustment measure	Mean number per patient		P
	PACT ^b	PIM ^c	
Total drugs filled			
Diabetes (n = 462)			.575
Prerandomization	1.3	1.4	
Post randomization	1.3	1.3	
Hypertension (n = 1380)			.126
Prerandomization	2.8	2.7	
Post randomization	2.7	2.7	
Hyperlipidemia (n = 833)			.006 ^d
Prerandomization	1.1	1.1	
Post randomization	1.0	1.1	
Depression (n = 693)			.102
Prerandomization	1.6	1.7	
Post randomization	1.6	1.6	
Drug class switches			
Diabetes	0.01	0.02	.388
Hypertension	0.10	0.10	.853
Depression	0.04	0.04	.746
New prescriptions			
Diabetes	0.23	0.25	.785
Hypertension	0.43	0.48	.159
Hyperlipidemia	0.13	0.19	.033
Depression	0.47	0.44	.527
Discontinued prescriptions			
Diabetes	0.27	0.27	.886
Hypertension	0.59	0.53	.135
Hyperlipidemia	0.28	0.21	.073
Depression	0.51	0.63	.045
Dose changes			
Diabetes	0.10	0.16	.101
Hypertension	0.31	0.25	.032
Hyperlipidemia	0.06	0.08	.432
Depression	0.24	0.18	.069

PACT, Patient Aligned Care Team; PIM, primary care intensive management; VHA, Veterans Health Administration.

^aPatients were included if they had prescription fills in either the pre- or postrandomization period.

^bPACT refers to patients assigned to usual primary care through the VHA's patient-centered medical home model, called Patient Aligned Care Team.

^cPIM refers to the intervention group, called the primary care intensive management group.

^dSignificant at Bonferroni-adjusted significance level of 0.01.

patients were not found to be a good fit for the intervention,⁸ so this may have limited our ability to detect differences in outcomes between care groups.

Although the amount of medication adjustments and the extent of improvements in adherence that we found in PIM patients were very modest, the PIM teams performed several activities that could potentially affect patients' medication management, such as

comprehensive assessment of patients' needs, educating patients about their medications, documenting patients' treatment goals, and visiting patients' homes to examine their supply of medications. Specifically, having an interdisciplinary team that incorporated mental health specialists and social workers could identify and address psychosocial issues affecting medication management in a comprehensive manner. Discussing treatment goals has also been shown to result in medication regimen simplification.³⁵ Our study population, however, may have been too heterogeneous to manage effectively. Programs such as PIM may result in limited impacts on outcomes without greater focus on patients amenable to intervention.

Limitations

We identified several potential limitations to our study. First, we observed medication adherence and adjustments in the 12-month period following assignment to PIM or PACT; however, this time period may have been too short to observe improvements in these outcomes because it took several months for PIM teams to contact patients after receiving the list of assigned patients. Second, we also excluded from our analysis patients who died during the follow-up period, although they may have had differential patterns in adherence compared with patients who survived. Third, we were not able to include several drug classes for diabetes—including insulin, meglitinide, thiazolidinedione (TZD), and glucagon-like peptide-1 (GLP-1) receptor agonists—due to lack of established methods for measuring adherence to injectable drugs such as insulin, low use of certain medications (meglitinide, TZD), or restricted VHA formulary (GLP-1 receptor agonists). Fourth, we were not able to include prescriptions not filled through a VHA pharmacy, although some patients may have filled their prescriptions through a non-VHA pharmacy through other insurance coverage or out-of-pocket payment. Fifth, we limited the drugs in our study to drugs to treat hypertension, hyperlipidemia, diabetes, and depression because most of the patients in the overall study had at least 1 of these conditions; we were unable to include all chronic medications in our study. Sixth, we used administrative data to investigate medication adherence rather than direct patient observation; although PDC is endorsed by quality measure experts as the measure of choice for medication adherence,^{36,37} there may have been changes in adherence or medication adjustments in drugs that we could not capture among PIM patients. Lastly, the study was not powered for medication adherence or medication adjustment outcomes, so this may have limited our ability to detect significant differences between treatment groups.

CONCLUSIONS

Overall, we found few differences in medication outcomes, with the notable exceptions of increased adherence to DPP-4 inhibitors for diabetes and increase in use of hyperlipidemia medications, among high-risk patients randomized to a VHA intensive outpatient management program. This program provided an interdisciplinary

approach, along with substantial resources, to assess high-risk patients' needs and tailor services to meet patients' goals for possible long-term improvements in health.

The potential of these programs to continue to develop and spread, however, may depend on better targeting of patients who are appropriate for intensive management interventions and on better understanding of the mechanisms needed to improve patients' adherence and self-management of chronic conditions. For example, more work is needed to examine whether the PIM teams identified the most pressing needs related to medication management of these high-risk patients, as well as to understand the effect of other factors related to adherence, such as patient comprehension of medication regimens. Emphasis on improving medication management in intensive programs that seek to improve outcomes among high-risk patients is paramount. ■

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eAppendix. Drug Classes Included in the Study

Diabetes
Biguanides
Sulfonylureas
Dipeptidyl peptidase-4 inhibitors
Hypertension
Angiotensin-converting enzyme inhibitors
Adrenergic blockers
Angiotensin receptor blockers
Beta blockers
Calcium channel blockers
Diuretics
Hyperlipidemia
Statins
Antidepressants
Selective serotonin reuptake inhibitor
Other antidepressant