Does Adherence to Medications for Type 2 Diabetes Differ Between Individuals With Vs Without Schizophrenia?

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Individuals with schizophrenia are at increased risk for poor health outcomes and mortality. This may be due to inadequate self-management of co-occurring conditions, such as type 2 diabetes. We compared adherence to oral hypoglycemic medications for diabetes patients with vs without comorbid schizophrenia. Using Veterans Affairs (VA) health system administrative data, we identified all patients with both schizophrenia and type 2 diabetes and with at least one oral hypoglycemic prescription fill in fiscal year 2002 (N 11 454) and a comparison group of patients with diabetes who were not diagnosed with schizophrenia (N 10 560). Nonadherence was operationalized as having a medication possession ratio indicating receipt of less than 80% of needed hypoglycemic medications. Poor adherence was less prevalent among diabetes patients with (43%) than without schizophrenia (52%, P < .001). In multivariable analyses, having schizophrenia was associated with a 25% lower likelihood of poor adherence compared with not having schizophrenia (adjusted odds ratio: 0.75, 95% confidence interval: 0.70–0.80). Poorer adherence was associated with black race, homelessness, depression, substance use disorder, and medical comorbidity. Having more outpatient visits, a higher proportion of prescriptions delivered by mail, lower prescription copayments, and more complex medication regimens were each associated with increased adherence. Among veterans with diabetes receiving ongoing VA care, overall hypoglycemic medication adherence was low, but individuals with comorbid schizophrenia were more likely to be adherent to these medications.

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Future studies should investigate whether factors such as comanagement of a chronic psychiatric illness or regular contact with mental health providers bestow benefits for diabetes self-management in persons with schizophrenia.

Key words: co-occurring medical conditions/administrative data

Introduction

Type 2 diabetes is a chronic medical condition that affects over 7% of the general US population at an annual cost of $132 billion.[1] Although hyperglycemia often presents with few outward symptoms, tight control of blood glucose is needed to prevent many of the short- and long-term complications of type 2 diabetes. Meeting recommended blood glucose goals requires active patient participation in order to master a complex array of self-management skills. These include modifying dietary choices, implementing exercise regimes, monitoring blood glucose, and adhering to often complex medication regimens. Medication adherence is a critical self-care activity that has been associated with positive diabetes outcomes, including enhanced blood glucose control,[2–7] having fewer hospitalizations[8] and lower health-care costs,[9–11] and possibly reduced mortality.[3] Unfortunately, many diabetes patients do not follow their medication regimens as prescribed, with estimates of nonadherence ranging from 36%–93%.[12]

Somatic medical conditions such as type 2 diabetes occur more frequently in individuals with schizophrenia than in the general population,[13] and the incidence of type 2 diabetes is increasing among those with schizophrenia.[14] Individuals with schizophrenia are also at increased risk for negative health outcomes and mortality.[15] Although this may be attributed to higher rates of smoking, obesity, metabolic syndrome, and other health risk factors among individuals with schizophrenia,[16] other factors, such as poor medication adherence, may also contribute to their poor health status. Many studies have demonstrated both poor adherence to antipsychotic medications among individuals with schizophrenia and negative consequences of poor adherence.[17–19] However,

there has been far less consideration of whether individuals with schizophrenia experience similar difficulties with adherence to treatments for co-occurring medical conditions.

Among the few studies to date, Dolder et al[20] observed that prescriptions for oral hypoglycemics were filled at appropriate intervals only 52% of the time over a 12-month period among 76 older Veterans Affairs (VA) health system patients with psychotic disorders and chronic medical conditions. Piette et al[21] evaluated medication adherence among VA patients with schizophrenia receiving pharmacologic treatment with antipsychotic, hypoglycemic, and antihypertensive medications. VA patients having comorbid schizophrenia, diabetes, and hypertension had a greater likelihood of poor adherence to diabetes and hypertension medications than for antipsychotics, and approximately one-third of patients were nonadherent to their oral hypoglycemic medications. Although these studies provide suggestive evidence that adherence to diabetes medications is problematic in individuals with schizophrenia, the absence of comparison groups of patients without mental illness precludes assessment of whether schizophrenia confers specific disadvantages in diabetes self-management.

Only one study has compared adherence to medications for a medical condition, hypertension, between individuals with and without psychotic disorders.[22] Although patients with psychotic disorders had worse blood pressure control, adherence to antihypertensives was similarly poor across the 2 groups, with patients having an average of 40 days without medications over the 1-year study period. The study was limited by a relatively small sample size of older VA patients that may have lacked adequate statistical power to detect important differences in adherence. Further, the study findings may not generalize to younger patients.

To our knowledge, no similar comparisons of adherence to diabetes medications between individuals with vs without schizophrenia have been conducted. The national VA health system is an excellent context in which to examine these issues. Each year, about 100 000 veterans with schizophrenia receive treatment in the VA health-care system.[23] Type 2 diabetes is more prevalent in VA patients (approximately 20%) than in the general population,[24] and it is the focus of substantial VA quality improvement efforts. Further, the VA's health information system provides a unique resource for national assessment of medication adherence among diabetes patients with and without schizophrenia. Previous work has shown that individuals with schizophrenia have difficulty adhering to antipsychotic medications and have multiple risk factors for poor medication adherence,[25] including cognitive difficulties, high rates of substance abuse disorders, and substantial psychiatric and somatic comorbidity. We hypothesized that among individuals with diabetes, those with comorbid schizophrenia would have poorer adherence to oral hypoglycemic medications than individuals without schizophrenia.

Methods

Data Sources and Study Samples

We used data from fiscal year (FY) 2001 through 2003 from the VA's National Psychosis Registry (NPR) to identify a cohort of patients with schizophrenia or schizoaffective disorder and type 2 diabetes. The NPR is a longitudinal resource that contains administrative encounter records of all inpatient and outpatient health services provided to veterans with psychotic disorders in VA facilities nationally. Records also include information on patients' demographic characteristics, *International Classification of Diseases, 9th Revision, Clinical Modification* (*ICD-9-CM*), diagnostic codes, and prescription fills. Using these records, we identified 104 298 patients with diagnoses of schizophrenia (*ICD-9-CM* 295.0–295.4, 295.6, 295.8–295.9) or schizoaffective disorder (295.7) in FY2002. Individuals included in this sample may have had records with *ICD-9-CM* diagnostic codes for other co-occurring psychiatric conditions, including major mood disorders. Of this sample, 17 099 (16%) had concurrent diagnoses of type 2 diabetes, defined as having had ≥2 inpatient or outpatient records with diagnostic codes of 250.0–250.9, 357.2, 362.0, or 366.41[24] in FY02, and 12 368 patients had one or more prescriptions for oral hypoglycemic medications in FY02. Due to the difficulty in measuring adherence to injectable medications from pharmacy data, we did not characterize adherence to insulin, and individuals only prescribed insulin were excluded from the study. We also excluded 760 who filled ≥2 outpatient prescriptions for oral hypoglycemic agents during an inpatient hospitalization and 154 patients who had no inpatient or outpatient encounters in the 12 months prior to their first oral hypoglycemic fill in FY02 or had fewer than 180 observation days following this date (due to death or institutionalization). Our final sample included 11 454 patients with type 2 diabetes and schizophrenia.

We used a similar algorithm to identify a comparison sample of veterans with ≥2 inpatient or outpatient records with diagnostic codes indicating type 2 diabetes who also filled one or more outpatient prescriptions for an oral hypoglycemic in FY02 but who did not have schizophrenia or schizoaffective disorder. We began with a national random sample of 100 000 veterans who had received VA inpatient or outpatient health services in FY02.[26] The procedure for generating the random sample of VA users in FY02 involved listing all veterans who had received VA inpatient or outpatient services in that year (per records in the VA's National Patient Care Database), assigning each individual a random number between 0 and 1, sorting the list on that number, and then taking the first 100 000 individuals. Among veterans

included in this simple random sample, we identified those who had not received any diagnoses of schizophrenia or schizoaffective disorders from VA providers during FY02 and who met study criteria for type 2 diabetes (N = 11 086). It should be noted that individuals included in this sample may have had major mental disorders other than schizophrenia, such as bipolar disorder or major depression. After excluding 158 patients who filled ≥2 oral hypoglycemic outpatient prescriptions as inpatients and 368 patients with no health services encounters in the 12 months prior to their first oral hypoglycemic fill in FY02 or with less than 180 observation days afterward, our final comparison sample consisted of 10 560 patients. The study was reviewed and approved by the Institutional Review Board of the VA Ann Arbor Health System, which granted a waiver of informed consent for access to patient health information.

Measures

Medication Adherence. To characterize adherence to oral hypoglycemic medications, we used automated prescription refill records to compute the medication possession ratio (MPR). The MPR is an objective and validated measure that has been widely used to characterize medication adherence in several chronic diseases, including diabetes[2,4,7,8,11] and schizophrenia.[17–19] Beginning with the date of the first prescription for an oral hypoglycemic in FY02, we assumed that treatment should be used continuously thereafter, and thus, we computed MPRs over the subsequent 12 months. The MPR is calculated by summing the total days' supply of medication dispensed from VA outpatient pharmacies and dividing it by the number of days supply required for continuous treatment during outpatient days within the period of observation. For patients receiving more than one oral hypoglycemic medication, we calculated MPRs separately for each agent and produced a weighted average MPR value. For descriptive purposes only, we used the same method to compute MPRs for antipsychotic medications for those in the schizophrenia sample.

Covariates. We included in our analysis several patient demographic and clinical characteristics, health services utilization patterns, and medication-related factors that have been shown to be associated with medication adherence. We included indicators of patient age, gender, race (coded as black, other race [white, American Indian, Asian, or Hispanic], or unknown race), marital status (married vs not married), and homelessness in the past 12 months. Using *ICD-9* diagnostic codes, we determined whether the patient was diagnosed with major depression, posttraumatic stress disorder (PTSD), or a substance use disorder. We also included a measure of overall medical comorbidity, the Charlson

Comorbidity Index score,[27] calculated as the sum of weighted values assigned to 19 categories of comorbidity and categorized as having values of 1 vs ≥2. In terms of health services utilization, we determined whether patients had inpatient hospitalizations for any health condition (classified for descriptive purposes as psychiatric-, diabetes-, or non-diabetes medical-related admissions) in the year prior to cohort entry. We also tabulated the total number of outpatient visits per person for the same 3 categories of services obtained in the previous year. With regard to attributes of patients' oral hypoglycemic medication regimens, we included indicators of the proportion (≤50% vs >50%) of prescription fills that were mailed to the patient rather than dispensed in person, the average days' supply of oral hypoglycemic prescriptions (≤60 vs > 60 days), and the number of different agents prescribed (and used in the calculation of the MPR) (1 or 2 vs ≥3 agents). Because veterans with military service–connected disabilities rated at least 50% are exempt from prescription copay requirements, we created a 3-level variable (not service connected, 0%–49% service connected, ≥50% service connected) for this measure. We also created an indicator of the overall complexity of each patient's medication regimen (the number of different classes other than oral hypoglycemics prescribed).

Analytic Plan. We first conducted bivariate analyses (*t* tests for continuous variables and chi-square tests for categorical variables) to compare diabetes patients with vs without a schizophrenia diagnosis. Comparisons assessed differences in demographic and clinical characteristics, use of health services, medication regimen characteristics, and unadjusted values of oral hypoglycemic MPRs. Consistent with prior studies, we defined medication nonadherence as having MPR values < 0.8 (or having less than 80% of medication needed for continuous treatment). MPR values ranging from 0.8–1.2 indicated adherence to prescribed treatment. A total of 873 individuals with MPR values exceeding 1.2, who had apparent excess supplies of medication that may have resulted from changes in medication dosages or from obtaining refills early, were excluded from multivariable analyses.

In multivariable analyses, we used a hierarchical data-analytic approach to adjust for the lack of independence among individuals receiving care from providers at the same VA facility. This approach would also adjust for any facility-level programs used to enhance medication adherence or any general adherence-focused milieu that may have differed across facilities. Using generalized estimating equations analysis, we examined the multivariable relationship between the dependent variable, poor adherence (MPR < 0.8) to oral hypoglycemic medications vs adherence (MPR = 0.8–1.2, the reference group), and the primary independent variable (yes/no

Table 1. Characteristics of Diabetes Patients With Vs Without Schizophrenia or Schizoaffective Disorder Treated in the Veterans Affairs Health-Care System in FY2002

Characteristic	Diabetes Patients With Schizophrenia or Schizoaffective Disorder (N = 11 454)		Diabetes Patients Without Schizophrenia or Schizoaffective Disorder (N = 10 560)		Test Statistic	P Value
	n	%	n	%		
Demographic characteristics						
Age, y (mean ± S.D)	55.7 (±10.7)		65.4 (±10.6)		$t = 67.1$	<.0001
Male gender	10 906	95	10 334	98	$\chi^2 = 113.2$	<.0001
Race					$\chi^2 = 1474.9$	<.0001
Black	3486	30	1299	12		
Other race[a]	7263	64	7419	70		
Unknown race	705	6	1842	18		
Married	3712	32	7027	67	$\chi^2 = 2562.5$	<.0001
Homeless in past year	1042	9	97	0.9	$\chi^2 = 749.1$	<.0001
Clinical characteristics						
Depression	1361	12	541	5	$\chi^2 = 318.0$	<.0001
Posttraumatic stress disorder	780	7	279	3	$\chi^2 = 208.4$	<.0001
Alcohol or substance use disorder	1473	13	137	1	$\chi^2 = 1083.7$	<.0001
Medical comorbidity						
Charlson Index = 1	6236	54	5738	54	$\chi^2 = 0.03$	.874
Charlson Index $\geq$ 2	5218	46	4822	46		
Service use, past year						
Medical, diabetes-related						
Hospitalization	1415	12	862	8	$\chi^2 = 104.1$	<.0001
Mean (±SD) no. of outpatient visits	6 (±8)		5 (±5)		$t = -12.9$	<.0001
Medical, non–diabetes-related						
Hospitalization	2050	18	1005	10	$\chi^2 = 322.9$	< .0001
Mean (±SD) no. of outpatient visits	24 (±31)		14 (±17)		$t = -28.8$	<.0001
Psychiatric						
Hospitalization	2031	18	72	0.7	$\chi^2 = 1848.6$	<.0001
Mean (±SD) no. of outpatient visits	25 (±58)		2 (±14)		$t = -42.8$	.0001
Medication regimen/payment characteristics						
Proportion of oral hypoglycemic prescriptions mailed					$\chi^2 = 72.9$	<.0001
≤50%	9080	79	7859	74		
>50%	2374	21	2701	26		
Average days' supply of oral hypoglycemic prescriptions					$\chi^2 = 743.8$	<.0001
≤60 days	5442	48	3123	30		
>60 days	6012	52	7437	70		
Number of different oral hypoglycemics prescribed					$\chi^2 = 0.13$	.720
1 or 2	10 490	92	9657	91		
≥3	964	8	903	9		
Military service connection/prescription copay					$\chi^2 = 2848.3$	<.0001
Not service connected	4124	36	7090	67		
0%–49%	1395	12	1575	15		
50%–100% (no prescription copay)	5935	52	1895	18		
Overall medication regimen complexity (mean ± SD)	7 (±5)		5 (±4)		$t = -28.7$	<.0001

[a]White, American Indian, Asian, or Hispanic

schizophrenia diagnosis). We produced odds ratios adjusted for all the covariates described above.

Results

Table 1 presents bivariate comparisons of the demographic, clinical, health services utilization, and medication regimen characteristics between the 11 454 diabetes patients with schizophrenia or schizoaffective disorder and the 10 560 diabetes without these psychiatric diagnoses receiving care in the VA health-care system in FY02. Individuals with schizophrenia disorders were, on average, 10 years younger than those without schizophrenia and included more female patients. The sample with schizophrenia consisted of a significantly larger proportion of black patients and smaller proportions of patients

Table 2. Multivariable Analysis of Nonadherence to Oral Hypoglycemic Medications Among VA Diabetes Patients With Vs Without Schizophrenia or Schizoaffective Disorder

Characteristic	Multivariable Analysis		
	Adjusted Odds Ratio[a]	95% Confidence Interval	*P* Value
Diagnosis of schizophrenia/schizoaffective disorder	0.75	0.70–0.80	<.0001
Demographic characteristics			
Age	1.00	0.99–1.00	.637
Male gender	0.87	0.74–1.02	.081
Black race[b]	1.37	1.27–1.48	<.0001
Unknown race[b]	1.01	0.92–1.11	.802
Married	0.99	0.93–1.06	.833
Homeless, past year	1.25	1.09–1.44	.002
Clinical and health services use characteristics			
Depression	1.25	1.12–1.38	<.0001
Posttraumatic stress disorder	1.02	0.89–1.16	.827
Alcohol or substance use disorder	1.45	1.28–1.64	<.0001
Medical comorbidity (Charlson Index ≥ 2)[c]	1.09	1.03–1.16	.005
Any hospitalization, past year	1.01	0.93–1.09	.867
Number of outpatient clinic visits, past year	0.996	0.995–0.997	<.0001
Medication regimen/payment characteristics			
>50% of oral hypoglycemic prescriptions mailed[d]	0.89	0.83–0.95	.001
Average days' supply of oral hypoglycemic prescriptions >60[e]	0.96	0.90–1.02	.158
≥ 3 Different oral hypoglycemics prescribed[f]	0.12	0.10–0.14	<.0001
0%–49% Military service connection[g]	1.08	0.99–1.18	.083
50%–100% Military service connection (no prescription copay)[g]	0.87	0.81–0.93	<.0001
Overall medication regimen complexity	0.98	0.97–0.99	<.0001

[a]Adjusted odds ratio, indicating risk of oral hypoglycemic (OH) medication possession ratio (MPR) < 0.8 (nonadherence) vs 0.8–1.2 (adherence).
Reference categories included in regression analysis were the following.
[b]Other race (white, Hispanic, Asian, American Indian).
[c]Charlson Index = 1.
[d]$\leq$50% of OH prescriptions received by mail.
[e]Average days' supply of OH prescriptions $\leq$ 60.
[f]1 or 2 OHs prescribed.
[g]Not service connected.

of other races and unknown race relative to the comparison sample. Fewer diabetes patients with schizophrenia were married, and a larger proportion had been homeless in the past year compared with those without schizophrenia. With regard to clinical characteristics, a significantly greater proportion of diabetes patients with schizophrenia than without schizophrenia had concurrent diagnoses of depression, PTSD, or alcohol/substance use disorders. The extent of overall medical comorbidity between the 2 groups was statistically similar. Compared with diabetes patients without schizophrenia, those with schizophrenia had considerably greater contact with the VA health-care system, as evidenced by higher rates of psychiatric and medical (diabetes- and non–diabetes-related) hospitalizations and greater numbers of all types of outpatient visits in the prior year. There were no differences between the patient groups with respect to the number of different oral hypoglycemic agents prescribed. However, fewer patients with schizophrenia received the majority of their oral hypoglycemic prescription fills by mail vs in person, and fewer received supplies of their medications covering greater than 60 days. Due to the prescription of psychotropic medications, diabetes patients with schizophrenia had more complex medication regimens overall than those without schizophrenia, but fewer patients with schizophrenia had prescription copayment requirements.

In unadjusted analyses, the prevalence of nonadherence to oral hypoglycemic medications (MPR < 0.8) was significantly lower (43% vs 52%), and the prevalence of adherence (MPR = 0.8–1.2) was significantly higher (51% vs 46%) in diabetes patients with schizophrenia than without schizophrenia (*P* < .0001). Also, a significantly larger proportion with schizophrenia (6%) had excess supplies of these agents (MPR > 1.2) relative to the comparison sample (2%) (*P* < .0001).

In multivariable regression analyses, we evaluated the likelihood of nonadherence to oral hypoglycemic medications (MPR < 0.8) relative to the likelihood of adherence

(MPR = 0.8–1.2); 649 diabetes patients with schizophrenia and 224 without schizophrenia who had MPR values > 1.2 were excluded from these analyses. Consistent with the results of the unadjusted analyses, we observed that individuals with schizophrenia were 25% less likely than diabetes patients without schizophrenia to be poorly adherent to oral hypoglycemic medications, controlling for demographic, clinical, health services use, and prescription-related characteristics (table 2).

Patient characteristics independently associated with poor adherence included black race, homelessness, depression, substance use disorder, and greater burden of medical comorbidity. Conversely, having a greater number of outpatient medical or psychiatric visits in the past year was associated with a lower likelihood of poor adherence to oral hypoglycemic medications. The probability of nonadherence was also lower if the majority of oral hypoglycemic prescriptions were delivered by mail (vs dispensed in person) and when prescription copays were not required. As the number of oral hypoglycemic agents prescribed and thus included in the MPR calculation increased, the likelihood of poor adherence was also reduced. Increasing complexity of the overall medication regimen was also associated with reduced odds of nonadherence to oral hypoglycemic agents. With regard to adherence to oral antipsychotic medications, among the 9022 diabetes patients with schizophrenia prescribed these agents, 35% met criteria for nonadherence to their antipsychotic regimens (MPR < 0.8), 54% met criteria for adherence (MPR = 0.8–1.2), and 11% had excess supplies (MPR > 1.2).

Discussion

This study is one of the largest to date comparing adherence to oral hypoglycemic medications among diabetes patients with and without schizophrenia. Contrary to our hypothesis and previous work that observed poorer quality of diabetes care in diabetes patients with than without mental illnesses,[28] we found that adherence to oral hypoglycemic medications was better among diabetes patients with schizophrenia than in diabetes patients without this diagnosis. These findings support a growing body of research that suggests that the quality of certain processes and intermediate outcomes of care related to adequate glycemic control are not compromised in diabetes patients with serious mental illnesses who are in ongoing care compared with those without these conditions.[29–34] Numerous studies in nonpsychiatric populations have demonstrated an association between adherence to oral hypoglycemic medications and enhanced control of blood glucose and other positive diabetes outcomes, including fewer hospitalizations and lower health-care costs.[2–11] Although determining whether diabetes patients with schizophrenia who exhibit superior medication adherence also have enhanced glyce-

mic control was beyond the scope of the current investigation, this important question merits continued study.

Relative to diabetes patients without schizophrenia, individuals with schizophrenia exhibited greater adherence to oral hypoglycemic medications despite having higher rates of several risk factors shown to be independently associated with medication nonadherence in this study. These characteristics, which we controlled for in multivariable analyses, included black race, homelessness, depression, and substance use disorders. Individuals with schizophrenia were also less likely to receive their prescriptions by mail, a characteristic associated with increased adherence in this study.

However, several characteristics shown to promote medication adherence also occurred more frequently in diabetes patients with schizophrenia. These patients had significantly greater contact with the health-care system overall, having had significantly more hospitalizations and a greater number of outpatient visits for diabetes-, non-diabetes medical-, and psychiatric-related reasons in the prior year. Further, those with schizophrenia had higher levels of military service–connected disability and lower out-of-pocket prescription costs as well as were prescribed more complex medication regimens, all observed to enhance medication adherence. However, in our multivariate analyses, we adjusted for all these risk and protective factors.

As such, other patient- or treatment-related attributes of those with diabetes and schizophrenia may help to explain why their adherence to oral hypoglycemic medications was clearly better than that observed in diabetes patients without schizophrenia. Somatic medical conditions such as diabetes occur significantly more frequently in people with schizophrenia, and many are treated with antipsychotic medications that induce metabolic adverse effects.[35] As such, mental health clinicians, family members, and patients with schizophrenia are paying greater attention to overall medical well being as well as to the potential medical consequences of psychiatric treatments.[36] This enhanced awareness may be leading to beneficial effects for patients in medication management and other aspects of diabetes treatment. In addition, schizophrenia, like diabetes, is a chronic medical condition that requires active self-care over many years to prevent short- and long-term adverse consequences. Although having a chronic psychiatric disorder is often disabling and can have deleterious effects on multiple aspects of patients' functioning and quality of life, the day-to-day self-management requirements for a psychiatric condition including medication taking may impart benefits, such as familiarity, in the treatment and outcomes of a co-occurring medical illness. Additional research is needed to confirm this hypothesis, particularly given the large volume of empirical evidence[17–19] and clinical experience attesting to schizophrenia patients' significant difficulties adhering

to antipsychotic treatments and the resultant adverse outcomes.

Despite our finding of schizophrenia patients having better adherence to diabetes medications than those without schizophrenia, our observation that nearly half of all patients, regardless of co-occurring psychiatric diagnosis, had less than 80% of needed medications over a 1-year period warrants serious attention by clinicians and researchers. The observed rates of nonadherence were consistent with the review by Cramer[12] but were higher than those from recent studies of the general population with diabetes, for which rates ranged from 20% to 35%.[2,3,8] Despite extensive diabetes quality improvement efforts implemented in the VA, the greater overall illness burden or life circumstances of VA patients[37] may explain the higher overall rates of nonadherence to diabetes medications that we observed. Our results were similar, however, to the few studies of adherence to diabetes medications conducted in patients with serious mental illness in the VA, which reported rates of nonadherence ranging from 29%–52%.[20,21] The results of our study suggest that efforts to improve adherence to diabetes medications are needed in all VA patients with diabetes and that such efforts should address several of the modifiable risk factors as well as the protective factors that we observed. For example, more research is needed to determine whether interventions that include reducing homelessness, adequately treating depression and substance use disorders, increasing contact with health-care providers, reducing out-of-pocket prescription costs, and increasing access to medications by mailing refills can have beneficial effects on medication adherence and subsequent diabetes outcomes.

While we were able to comment on several patient and treatment characteristics associated with medication nonadherence in this study, we were unable to investigate the role of other potential factors that might have influenced medication adherence among these patients, including insight into illness, the quality of the patient-provider therapeutic alliance, and patients' attitudes toward diabetes and its complications. Further, because our study focused exclusively on the largely older, male population of patients receiving care in the VA health-care system, our results may not generalize to other diabetes patients receiving care in different treatment settings that place less (or more) emphasis on the quality of processes and outcomes of diabetes care. Our study was also limited to individuals with diagnosed diabetes, so the prevalence of the disorder is likely higher than we observed. Further, although everyone included in the study had used VA inpatient or outpatient health-care services in the past year, many VA patients also receive health services outside of the VA system,[38] and we were unable to account for this with the data source we used for this study. Our data also did not permit us to account for the known deleterious effects of cognitive impairments on medication adherence. But if we presume that cognitive impairments were worse in the schizophrenia group than in the nonmentally ill group,[39] the higher adherence levels among patients with schizophrenia would suggest that cognitive impairments did not in this case severely disadvantage such patients. Finally, we did not examine whether individuals in the comparison group with major mental illnesses other than schizophrenia exhibited similar patterns of adherence to oral hypoglycemic medications as those with schizophrenia. Because the prevalence of type 2 diabetes is also elevated in individuals with other psychiatric illnesses such as major depressive disorder and bipolar disorder, patterns of use of diabetes medications in these patients merit further study.

Among the strengths of our investigation were the large sample size of diabetes patients with schizophrenia and an equally large comparison sample of patients without schizophrenia receiving diabetes care in similar treatment settings. In addition, we were advantaged by the availability of VA administrative pharmacy data that enabled us to use the MPR as our measure of medication adherence as opposed to other subjective methods including patient and clinician self-reports that have been shown to overestimate adherence.[40] The MPR is an objective, unobtrusive, and validated measure of adherence that has been widely used in studies characterizing adherence to both diabetes and schizophrenia medications and has been linked to disease outcomes.[2,4,7,8,11,17–19]

In conclusion, this large investigation revealed that diabetes patients with schizophrenia exhibited superior adherence to oral hypoglycemic medications relative to a comparable sample of diabetes patients actively receiving care in the VA health-care system. The linkage of adherence to glucose control as well as the reasons driving this advantage require further study in order to improve patient outcomes in the future.

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