Prevalence of Baseline Serum Glucose and Lipid Testing in Users of Second-Generation Antipsychotic Drugs: A Retrospective, Population-Based Study of Medicaid Claims Data

Elaine H. Morrato, Dr.P.H., M.P.H.; John W. Newcomer, M.D.; Richard R. Allen, M.S.; and Robert J. Valuck, Ph.D.

Objective: Increased risk of diabetes and dyslipidemia is associated with major mental illness and antipsychotic drug use. This study aimed to determine the prevalence of serum glucose and lipid monitoring in public mental health clients initiating second-generation antipsychotic (SGA) drugs.

Method: This retrospective cohort study using Medicaid claims data from California, Oregon, Tennessee, and Utah evaluated 55,436 enrollees with a prescription claim for an SGA drug between January 1, 1998, and December 31, 2003. Serum glucose and lipid testing were identified using Current Procedural Terminology (CPT) procedure codes. Baseline was defined as 14 days before through 28 days after the date of the first SGA prescription. Multivariate logistic regression identified patient characteristics associated with testing. Generalized estimating equations evaluated changes associated with SGA drug initiation compared to background rates of testing.

Results: On average, < 20% of individuals initiating SGA drug therapy received baseline glucose testing, and < 10% received baseline lipid testing. Baseline glucose and lipid testing increased modestly with SGA initiation (glucose: 7%–11% increase; lipids: 2%–3% increase; $p < .001$). Preexisting diabetes and dyslipidemia were associated with a 2- to 3-fold greater likelihood of baseline glucose and lipid testing. The likelihood of glucose testing increased 2-fold between 1998 and 2003 and was 46% more likely in patients with schizophrenia. Enrollees from Oregon, Tennessee, and Utah were 50% to 90% less likely to receive baseline glucose or lipid testing than enrollees from California.

Conclusions: Glucose and lipid screening is underutilized in patients initiating SGA drug therapy. Psychiatrists can play an important role to ensure metabolic risk is adequately assessed.

(J Clin Psychiatry 2008;69:316–322)

Received Feb. 27, 2007; accepted June 7, 2007. *From the Department of Pediatrics and the Department of Preventive Medicine and Biometrics, School of Medicine (Dr. Morrato), and the Department of Clinical Pharmacy, School of Pharmacy (Drs. Morrato and Valuck), University of Colorado at Denver; the Departments of Psychiatry, Psychology, and Medicine, Washington University School of Medicine, St. Louis, Mo. (Dr. Newcomer); and Peak Statistical Services, Evergreen, Colo. (Mr. Allen).*

This research study was unfunded and investigator-initiated. Dr. Newcomer's effort was supported in part by National Institute of Mental Health grant MH63985.

This study was presented in part at the 58th Institute on Psychiatric Services; Oct. 5–8, 2006; New York, N.Y.

Acknowledgments and financial disclosure are listed at the end of the article.

Corresponding author and reprints: Elaine H. Morrato, Dr.P.H., University of Colorado at Denver, Colorado Health Outcomes Program, Mailstop F443, Building 406, T09-105, 12477 E. 19th Ave., P.O. Box 6508, Aurora, CO 80045-0508 (e-mail: elaine.morrato@uchsc.edu).

The U.S. Surgeon General concluded almost a decade ago that mental health is "inextricably intertwined" with physical health and a high-quality mental health system must integrate primary medical care with psychiatric treatment.[1] As the Centers for Disease Control recently reported, persons with serious mental illness have a higher risk of death compared to the general population, primarily due to cardiovascular disease,[2] with an average of more than 20 years of potential life lost.[2,3] Excess mortality has been attributed to poorer quality of medical care and lower socioeconomic status[4,5] and to patient lifestyle, which can include poor dietary habits,[6] obesity,[7] physical inactivity,[8] and high rates of smoking.[9] Metabolic syndrome and diabetes, both associated with elevated cardiovascular risk, are also particularly prevalent among individuals with serious mental illness. Four of 10 patients with schizophrenia meet the criteria for having metabolic syndrome,[10] and about 1 in 6 schizophrenia patients has diabetes[11,12]; both rates are about double the rate found in the general population.[13] Moreover, schizophrenia is a recognized risk factor for developing type 2 diabetes.[14]

Further complicating the clinical challenge in managing psychiatric patients with these complex chronic medical conditions is the fact that second-generation

antipsychotic (SGA) drug therapy is itself associated with weight gain, insulin resistance, and dyslipidemia.[15–17] Because of this safety risk, the U.S. Food and Drug Administration required a warning about increased risk for hyperglycemia and diabetes to be added to the product labeling for all SGA drugs.[18] Recommendations from the American Diabetes Association (ADA) and American Psychiatric Association (APA) Consensus Development Conference specified that metabolic monitoring, including baseline assessment of serum glucose and lipid profiles, should be done for all patients initiating SGA drugs.[19] Because mental health care providers have the most direct contact with schizophrenia patients, Marder et al.[20] have recommended that they be responsible for basic health screening, including metabolic testing. Fenton and Chavez[21] acknowledge that screening responsibilities may need to reflect individual practice circumstances, although the provider responsible for ongoing monitoring of metabolic risk should be explicitly identified.

Achieving recommended levels of metabolic screening is therefore important for clinicians treating patients with serious mental illness and for those prescribing SGA medications, especially because a substantial portion of these patients has undiagnosed diabetes.[22,23] However, the frequency of serum glucose and lipid testing in patients with serious mental illness, specifically those receiving antipsychotic medication, is understudied.[23–28] Data suggest that less than 10% of managed-care patients receiving SGA drugs are being monitored in a manner consistent with ADA/APA recommendations.[27] However, information on the rate of testing for public health clients, for whom serious mental illness and antipsychotic utilization is common,[29] is lacking.

The aim of this retrospective, population-based cohort study was to determine the prevalence of baseline serum glucose and lipid testing for public mental health clients enrolled in Medicaid who were initiating SGA drug therapy. A secondary objective was to identify factors associated with a greater likelihood of testing.

METHOD

Source Population

This retrospective cohort was selected from individuals enrolled in the California, Oregon, Utah, or Tennessee Medicaid programs between January 1, 1998, and December 31, 2003. Individuals from California, Oregon, and Utah were enrolled in fee-for-service plans, and individuals from Tennessee participated in TennCare, a network of managed care organizations. Study subjects were excluded if they were Medicare dual-eligible. Each enrollee had a unique encrypted identifier, which allowed us to identify all medical and pharmacy claim records for each patient during the study period. Given the anonymous nature of the data, the Colorado Multiple Institutional Review Board determined that the protocol was exempt from IRB review.

Study Population

Enrollees with a prescription claim for an SGA drug (aripiprazole, clozapine, olanzapine, quetiapine, risperidone, or ziprasidone) and a 180-day enrollment history before the index SGA pharmacy drug claim were selected (N = 55,436). The index drug claim was the first SGA prescription in the study period. A patient was classified as receiving multiple SGA drugs if he or she had prescription claims for 2 or more SGA drugs on the index day. The likelihood of baseline metabolic testing was compared between index drugs using risperidone as the referent because risperidone was the SGA drug most commonly prescribed.

Ascertainment of Metabolic Testing

Glucose testing was identified using Current Procedural Terminology, 4th Revision (CPT) codes for a comprehensive metabolic panel (CPT codes 80050, 80053, and 80054), glucose test (82947, 82948, 82950, 82951, 81000, 81002, 81005, 81099), glycolated hemoglobin (A1C) test (83036), or home glucose monitoring device (82962).[30] This definition was designed to maximize sensitivity to the range of testing a physician might use to assess glucose metabolism. Lipid testing was defined as the presence of a lipid panel (CPT code 80061) or individual tests (CPT codes 83721, 83715, 83716, or [83718 and 82465 and 84478]).[30]

Prevalence of Baseline Testing

The APA recommends that glucose and lipid profiles be assessed when initiating SGA treatment.[19] The prevalence of baseline testing was calculated as the proportion of individuals initiating SGA medication who had at least 1 medical claim for a glucose or lipid test during the baseline period of 14 days before to 28 days after the index SGA drug claim. The prevalence of glucose and lipid testing in 2003 (the most recent year in the study cohort) was also calculated for four 30-day time periods before and after the index atypical antipsychotic prescription claim date and stratified by diabetes status to compare baseline testing associated with SGA initiation to background rates of testing. Patients included in this analysis had at least 120 days of enrollment history after the index SGA prescription claim.

Assessment of Mental and Physical Health

Because patients with schizophrenia are at higher risk for developing type 2 diabetes[14] and the ADA recommends that adults with risk factors be screened more often,[31] the likelihood of baseline testing was compared in patients with versus without schizophrenia. Individuals with diagnosed schizophrenia were identified by the

Table 1. Prevalence of Baseline Glucose and Lipid Serum Testing Among Patients Initiating Second-Generation Antipsychotic (SGA) Drug Therapy[a]

Selected Characteristic	N (%)	Baseline Glucose Serum Test, %	Baseline Lipid Serum Test, %
Total population	55,436 (100)	19.0	6.2
Sex			
Female	27,842 (50.2)	21.1	6.8
Male	27,594 (49.8)	16.8	5.6
Age group, y			
19 or younger	17,527 (31.6)	12.1	2.3
20–29	7,470 (13.5)	17.2	4.8
30–39	10,599 (19.1)	20.2	6.6
40–49	11,023 (19.9)	23.4	9.4
50–59	6,988 (12.6)	27.7	11.3
60–69	862 (1.6)	30.5	11.0
70 or older	967 (1.7)	20.5	4.3
Race/ethnicity			
White	32,286 (58.2)	17.8	5.9
Nonwhite	23,150 (41.8)	20.7	6.6
State			
California	46,471 (83.8)	21.1	7.2
Oregon	657 (1.2)	4.4	< 1.0
Tennessee	5,934 (10.7)	8.8	1.3
Utah	2,374 (4.3)	7.1	< 1.0
Schizophrenia			
No	11,278 (20.3)	17.9	5.6
Yes	44,158 (79.7)	23.3	8.5
Preexisting diabetes			
No	50,589 (91.3)	16.9	5.4
Yes	4,847 (8.7)	40.9	14.3
Preexisting dyslipidemia			
No	50,144 (90.5)	17.4	4.7
Yes	5,292 (9.5)	34.3	19.9
Index SGA drug			
Aripiprazole	104 (< 1.0)	25.3	4.8
Clozapine	130 (< 1.0)	18.5	13.8
Olanzapine	22,290 (40.2)	20.7	7.4
Quetiapine	7,933 (14.3)	19.3	5.6
Risperidone	22,494 (40.6)	16.9	5.1
Ziprasidone	889 (1.6)	19.2	7.4
Multiple	1,596 (2.9)	23.3	6.2
Year of index SGA prescription			
1998	3,498 (6.3)	12.7	7.4
1999	7,896 (14.2)	13.0	7.3
2000	9,213 (16.6)	13.9	5.6
2001	10,526 (19.0)	21.0	5.4
2002	12,658 (22.8)	22.4	6.3
2003	11,645 (21.0)	23.4	5.9

[a]Data are based on Medicaid enrollees from California, Oregon, Tennessee, and Utah (1998–2003). Baseline was defined as 14 days before, through 28 days after, the date of the initial SGA prescription claim.

presence of a medical claim during the study period with an *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis code of 295.xx.

Patients with diabetes or dyslipidemia would also be expected to receive glucose and lipid testing more often. In order to maximize our sensitivity in classifying patients,[32] individuals with preexisting diabetes were identified by the presence of a medical claim coded for diabetes (ICD-9-CM code 250.xx) or a pharmacy claim for an antidiabetic drug (Generic Product Identifier [GPI; First DataBank, Inc., Indianapolis, Ind.] code 27) in the 180 days before the index SGA claim date. Similarly, individuals with preexisting dyslipidemia were identified by the presence of a medical claim coded for disorders of lipid metabolism (ICD-9-CM code 272.xx) or a pharmacy claim for an antihyperlipidemia drug (GPI code 39) in the 180 days before the index SGA claim date.

Assessment of Patient Demographic Characteristics

Sex, age at the time of the index SGA prescription claim, race/ethnicity, and state Medicaid program were also known for each patient. Race and ethnicity were classified as white, African American, Hispanic, or Asian. Because nonwhite race/ethnicity is a risk factor for developing type 2 diabetes,[33] the likelihood of baseline metabolic testing was compared in nonwhite versus white race/ethnicity.

Year of the Index SGA Prescription Claim

Increasing clinical reports of the association between SGA drug use and glucose metabolism abnormalities began appearing in the medical literature in 1999.[34] To evaluate whether the prevalence of metabolic testing increased over time with increasing medical reports, the likelihood of baseline testing was compared by year of the index SGA prescription using 1998 as the referent.

Statistical Analysis

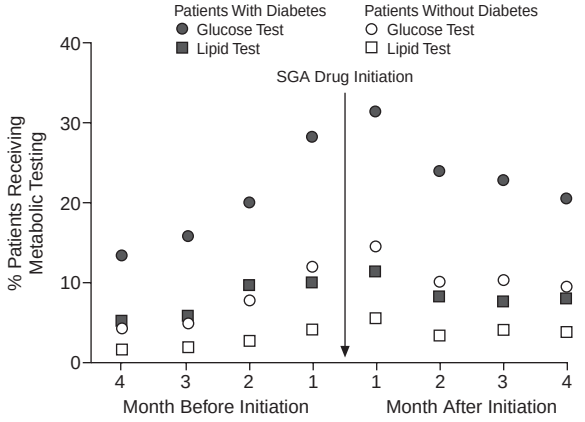
Multiple logistic regression was performed to estimate the adjusted odds of baseline glucose and lipid testing after controlling for sex, age, race/ethnicity, state Medicaid program, diabetes, dyslipidemia, schizophrenia, index SGA drug (excluding aripiprazole due to insufficient sample), and year of the index SGA prescription claim. Generalized estimating equations were used to test for changes in the proportion of patients initiating atypical antipsychotic drug therapy who received metabolic testing in the months before and after initiation. Statistical analyses were conducted using SAS version 9.1.3 (SAS Institute, Inc., Cary, N.C.).

RESULTS

Patient Characteristics

Table 1 summarizes characteristics of patients in the study cohort who initiated SGA drug therapy in California, Oregon, Tennessee, and Utah between 1998 and 2003. One half of the study population was female and slightly more than one half was white. In this sample, 80% of patients had a recorded diagnosis of schizophrenia. Based on recorded diagnoses and antidiabetic and antihyperlipidemia drug prescribing, 9% of patients were identified as having diabetes, and 10%, dyslipidemia.

Figure 1. Prevalence of Metabolic Testing Relative to Initiation of Second-Generation Antipsychotic (SGA) Drug Therapy in Patients With and Without Identified Diabetes[a]



[a]Data are based on Medicaid enrollees from California, Oregon, Tennessee, and Utah in 2003.

Risperidone (41%) and olanzapine (40%) were the most common index SGA drugs. The majority of the study cohort was from California.

Prevalence of Metabolic Testing

Overall, 19% of patients received a baseline glucose test; 6% received a lipid test; and 5% received both tests. Expanding the baseline period to include 4 months before and 4 months after the index SGA drug claim, there was a 7% to 11% increase in glucose testing ($p < .001$) and a 2% to 3% increase in lipid testing ($p < .001$) in the month before and after SGA drug initiation compared to the average background rate of testing 2 to 4 months before drug initiation (Figure 1). The absolute increase in testing in the month before and after drug initiation compared to background rates was greatest in glucose testing for patients with preexisting diabetes.

Predictors of Metabolic Testing

Table 2 summarizes factors associated with the adjusted likelihood of baseline metabolic testing. Male and nonwhite patients were less likely to receive baseline glucose testing compared to female and white patients, but there was no association between gender or race and baseline lipid testing. Individuals were significantly ($p < .05$) more likely to receive glucose and lipid screening if they were enrolled in the California Medicaid program. Baseline glucose testing increased significantly between 1998 and 2003 (OR = 2.51, 95% CI = 2.24 to 2.81); however, there was no change in rates of baseline lipid testing. Individuals with a recorded diagnosis of schizophrenia were more likely to receive baseline glucose screening but were no more likely to receive lipid screening. Preexisting diabetes and dyslipidemia were associated with a 2- to 3-fold greater likelihood of baseline glucose and lipid testing. Patients initiating olanzapine were more likely to receive baseline glucose and lipid testing than patients initiating risperidone. Baseline lipid testing was also more likely for patients initiating clozapine or ziprasidone.

Table 2. Factors Associated With Baseline Metabolic Testing Among Individuals Initiating Second-Generation Antipsychotic (SGA) Drug Therapy[a]

	Likelihood of Baseline Serum Laboratory Testing, OR (95% CI)[b]	
Selected Characteristic	Glucose	Lipid
Sex (ref = female)	0.83 (0.79 to 0.87)	0.99 (0.92 to 1.06)
Age group, y (ref = 20–29)		
19 or younger	0.78 (0.72 to 0.84)	0.57 (0.49 to 0.66)
30–39	1.12 (1.03 to 1.21)	1.21 (1.06 to 1.38)
40–49	1.20 (1.11 to 1.30)	1.49 (1.31 to 1.69)
50–59	1.34 (1.23 to 1.46)	1.49 (1.30 to 1.71)
60–69	1.56 (1.32 to 1.84)	1.57 (1.23 to 2.01)
70 or older	1.35 (1.12 to 1.62)	1.01 (0.72 to 1.42)
Race/ethnicity (ref = white)	0.93 (0.89 to 0.98)	1.04 (0.97 to 1.12)
State (ref = California)		
Oregon	0.23 (0.16 to 0.34)	0.10 (0.03 to 0.31)
Tennessee	0.46 (0.42 to 0.51)	0.24 (0.19 to 0.30)
Utah	0.27 (0.23 to 0.32)	0.12 (0.07 to 0.18)
Schizophrenia (ref = no)	1.46 (1.38 to 1.54)	1.40 (1.29 to 1.53)
Preexisting metabolic disorder		
Diabetes (ref = no)	2.49 (2.32 to 2.66)	1.51 (1.37 to 1.66)
Dyslipidemia (ref = no)	1.49 (1.39 to 1.59)	3.35 (3.07 to 3.66)
Index SGA drug (ref = risperidone)		
Aripiprazole	1.18 (0.71 to 1.96)	1.28 (0.50 to 3.26)
Clozapine	1.04 (0.66 to 1.63)	2.35 (1.39 to 3.95)
Olanzapine	1.13 (1.08 to 1.19)	1.21 (1.18 to 1.31)
Quetiapine	0.94 (0.88 to 1.01)	0.97 (0.75 to 1.15)
Ziprasidone	0.84 (0.71 to 1.01)	1.42 (1.09 to 1.86)
Multiple	1.24 (1.09 to 1.40)	0.93 (0.75 to 1.15)
Year of index SGA prescription (ref = 1998)		
1999	1.13 (1.00 to 1.28)	1.12 (0.96 to 1.32)
2000	1.30 (1.15 to 1.46)	0.89 (0.76 to 1.05)
2001	2.30 (2.06 to 2.58)	0.88 (0.75 to 1.03)
2002	2.39 (2.14 to 2.67)	0.95 (0.82 to 1.11)
2003	2.51 (2.24 to 2.81)	0.86 (0.74 to 1.00)

[a]Data are based on Medicaid enrollees from California, Oregon, Tennessee, and Utah (N = 55,436). Baseline was defined as 14 days before, through 28 days after, the date of the initial SGA prescription claim.
[b]Odds ratios were obtained from logistic regression models adjusting for sex, age, race/ethnicity, state Medicaid program, year of the index SGA prescription, the SGA drug prescribed, and the presence of schizophrenia and preexisting diabetes and dyslipidemia.
Abbreviation: ref = reference.

DISCUSSION

In this Medicaid population, the rates of baseline metabolic screening were low. On average, less than 20% of individuals initiating SGA drug therapy received baseline serum glucose testing and less than 10% received lipid testing. These findings are even more discouraging given the fact that metabolic screening was lower in patients without preexisting diabetes or dyslipidemia. However,

results from our study are consistent with previous reports of low metabolic monitoring in the community for psychiatric patients taking antipsychotic medication,[23,27] and our results now extend this observation into the public Medicaid sector, where many patients with serious mental illness receive health care. Findings from this study suggest a large gap existed between clinical practice and the ADA's and APA's goal of fasting serum glucose and lipid profiles for all patients initiating SGA drug therapy.

Some might argue, though, that the rates of baseline glucose and lipid screening have increased since these data were collected and after the FDA's warning on hyperglycemia risk and the ADA/APA's consensus recommendations. For example, surveys of psychiatrists indicate that their overall awareness of the risk for diabetes with SGA drug therapy increased after the warnings.[35,36] However, results from a population-based study examining glucose and lipid testing trends in a commercially insured population suggest monitoring did not change following the warning.[27] This finding is consistent with postwarning survey results showing that less than 20% of psychiatrists reported assessing fasting serum glucose and lipid profiles before initiating treatment with SGA drug therapy.[35] Screening for metabolic side effects has also remained low in the United Kingdom, where only one quarter of community patients receiving antipsychotic medication in 2005 received a blood glucose or plasma lipid test in the past year.[28] While we are currently evaluating the effect of the warnings and ADA/APA recommendations on metabolic testing patterns in Medicaid patients, we suspect that a gap between clinical practice and medical and public health goals will remain.

On a positive note, though, rates of glucose testing improved over time during the study period, and there was an increase in glucose testing associated with SGA drug initiation. These facts suggest that diabetes screening was increasing; however, the question that this retrospective study could not answer, and one that should be addressed by future research, is, who ordered the testing? and why? That is, did the prescriber of the antipsychotic medication order the testing, or, if not, was he or she aware of and able to easily obtain the results? We know the U.S. mental health system is complex and fragmented[1] and that only 1 in 7 Medicaid psychiatric visits provides preventive health services.[37] However, we have observed in this same Medicaid study population that one half of SGA patients without diabetes and more than three quarters with diabetes had an annual glucose test.[38] Perhaps one opportunity for improved coordination of metabolic monitoring may be to ensure, at minimum, that existing laboratory results from other health care settings are available to the SGA-prescribing clinician.

Interestingly, there was significant ($p < .05$) variability in metabolic testing rates across the 4 states studied. Medicaid enrollees from Oregon, Tennessee, and Utah were 50% to 90% less likely to receive metabolic testing than those in California. Because data from California represented the majority of our study sample, mean rates of glucose and lipid testing thus largely reflect practices in California. The need for improved integration of primary medical care with psychiatric treatment across all states has been noted.[39,40] Understanding the California model of care may provide insight for other states endeavoring to increase metabolic screening for patients with serious mental illness.

We also observed variability in the likelihood of baseline testing across SGA drugs. For example, glucose testing was more likely if the patient was initiating quetiapine or ziprasidone rather than risperidone. It is unclear why this variation occurred, especially since it appears to counter the understanding that quetiapine has a similar metabolic risk profile to risperidone, and ziprasidone is associated with a lower metabolic risk.[15] Perhaps this variability reflects a differential in monitoring practices among physicians who were adopters of quetiapine and ziprasidone—or a differential in metabolic risk profile for the patients typically prescribed these 2 drugs; these possibilities could not be assessed using the available administrative claims data. More research is needed to investigate this finding and to evaluate whether a disparity in monitoring across drugs exists today. Until corroboration has occurred, these results should be treated with caution.

The results of this research are subject to limitations. The prevalence of baseline metabolic risk assessment relied on laboratory testing alone and clinician adoption of other recommended risk assessment measures, e.g., family history, waist circumference, and body mass index, could not be evaluated. For example, about 80% of psychiatrists have reported assessing patient and family history and 60% have reported measuring height and body weight more than one half the time when initiating SGA drug therapy.[35] In addition, this study examined only whether or not a glucose or lipid test was done, not what the laboratory results were and how the clinician may have adjusted his or her treatment plan accordingly. Data from the Clinical Antipsychotic Trials of Intervention Effectiveness (CATIE) indicate that 30% of patients with schizophrenia and diabetes and nearly 90% with dyslipidemia do not receive treatment for these metabolic disorders.[41] Although the states included in this study represented one quarter of Medicaid enrollees,[42] caution should also be applied in generalizing study findings nationally or to other reimbursement settings. Moreover, major budget cuts in state Medicaid funding occurred after the study time period,[39] so our findings may not reflect current testing practices.

People with serious mental illness are at increased risk for cardiovascular disease and diabetes. Second-generation antipsychotic drug therapy further contributes to patients' risk for developing diabetes and dyslipidemia.

Results from this study suggest that serum glucose and lipid testing, as a tool for metabolic risk assessment, is greatly underutilized in Medicaid patients initiating SGA drug therapy. The adoption of metabolic monitoring into clinical practice should continue to be emphasized and supported. Psychiatrists are in an important position to ensure that metabolic risk is monitored before and during the course of SGA drug therapy so patients get the best quality of care.

Drug names: aripiprazole (Abilify), clozapine (Clozaril, FazaClo, and others), olanzapine (Zyprexa), quetiapine (Seroquel), risperidone (Risperdal), ziprasidone (Geodon).

Acknowledgments: The authors acknowledge the collective efforts of the members of the Medicaid Pharmacotherapy Research Consortium (MPRC) for their assistance in data acquisition and manuscript review. Members of the MPRC involved with this study include coauthor Robert J. Valuck, Ph.D. (Colo.), as well as Gary M. Oderda, Pharm.D. (Utah); Dean G. Haxby, Pharm.D. (Ore.); and Vic Walker, R.Ph., B.C.P.P. (Calif.). Drs. Oderda, Haxby, and Walker report no financial or other relationships relevant to the subject of this article.

Financial disclosure: **Dr. Morrato** has received grant/research support from Pfizer, Eli Lilly, and Janssen. Dr. Morrato has no pertinent financial conflict of interest according to the University of Colorado at Denver and Health Sciences Center Conflict of Interest policies. **Dr. Newcomer** has received grant support from the National Institute of Mental Health, the National Alliance for Research on Schizophrenia and Depression, the Sidney R. Baer, Jr. Foundation, Janssen, Pfizer, Bristol-Myers Squibb, and Wyeth; is a consultant for Janssen, Pfizer, Bristol-Myers Squibb, AstraZeneca, GlaxoSmithKline, Organon, Solvay, and Wyeth; is a member of the Data Safety Monitoring Committee for Organon; is a consultant to litigation; and receives product development royalties from Compact Clinicals. Dr. Newcomer has no significant financial conflict of interest according to the Washington University School of Medicine Conflict of Interest Policy. **Mr. Allen** is an independent statistician who has provided statistical services for the U.S. Food and Drug Administration and GlaxoSmithKline. **Dr. Valuck** has received grant/research support from the National Institute of Diabetes and Digestive and Kidney Disorders, Janssen, Pfizer, Forest, and Eli Lilly; serves on an advisory board for Eli Lilly; and is a medical-legal consultant on product liability and pharmacist standard-of-care cases. Dr. Valuck has no pertinent financial conflict of interest according to the University of Colorado at Denver and Health Sciences Center Conflict of Interest policies.

REFERENCES

1. US Department of Health and Human Services. Mental Health: A Report of the Surgeon General. Rockville, Md: US Dept Health Human Services, Substance Abuse and Mental Health Services Administration, Center for Mental Health Services, National Institutes of Mental Health; 1999
2. Colton CW, Manderscheid RW. Congruencies in increased mortality rates, years of potential life lost, and causes of death among public mental health clients in eight states. Prev Chronic Dis 2006;3:A42. Available at: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1563985. Verified Aug 22, 2007
3. Newman S, Bland R. Mortality in a cohort of patients with schizophrenia: a record linkage study. Can J Psychiatry 1991;36:239–245
4. Osby U, Correia N, Brandt L, et al. Mortality and causes of death in schizophrenia in Stockholm County, Sweden. Schizophr Res 2000;45:21–28
5. Druss BG, Bradford WD, Rosenheck R, et al. Quality of medical care and excess mortality in older patients with mental disorders. Arch Gen Psychiatry 2001;58:565–572
6. McCreadie R. Diet, smoking and cardiovascular risk in people with schizophrenia: descriptive study. Br J Psychiatry 2003;183:534–539
7. Allison D, Fontaine K, Heo M, et al. The distribution of body mass index among individuals with and without schizophrenia. J Clin Psychiatry 1999;60:215–220
8. Daumit GL, Goldberg R, Anthony C, et al. Physical activity patterns in adults with severe mental illness. J Nerv Ment Dis 2005;193:641–646
9. de Leon J, Dadvand M, Canusa C, et al. Schizophrenia and smoking: an epidemiological survey in a state hospital. Am J Psychiatry 1995;152:453–455
10. McEvoy JP, Meyer JM, Goff DC, et al. Prevalence of the metabolic syndrome in patients with schizophrenia: baseline results from the Clinical Antipsychotic Trials of Intervention Effectiveness (CATIE) schizophrenia trial and comparison with national estimates from NHANES III. Schizophr Res 2005;80:19–32
11. Mukherjee S, Decina P, Bocola V, et al. Diabetes mellitus in schizophrenia patients. Compr Psychiatry 1996;37:68–73
12. Dixon L, Weiden P, Delahanty J, et al. Prevalence and correlates of diabetes in national schizophrenia samples. Schizophr Bull 2000;26:903–912
13. American Diabetes Association. Total Prevalence of Diabetes and Prediabetes. Available at: http://www.diabetes.org/diabetes-statistics/prevalence.jsp. Verified Sept 26, 2006
14. Canadian Diabetes Association. Canadian Diabetes Association 2003 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada. Can J Diabetes 2003;27(suppl 2):S1–S152
15. Newcomer JW. Metabolic considerations in the use of antipsychotic medications: a review of recent evidence. J Clin Psychiatry 2007;68(suppl 1):20–27
16. Lean ME, Pajonk FG. Patients on atypical antipsychotic drugs: another high-risk group for type 2 diabetes. Diabetes Care 2003;26:1597–1605
17. Lieberman JA, Stroup T, McEvoy J, et al. Effectiveness of antipsychotic drugs in patients with chronic schizohrenia. N Engl J Med 2005;353:1209–1223
18. US Food and Drug Administration. Warning about hyperglycemia and atypical antipsychotic drugs. FDA Patient Safety News, June 2004. Available at: http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/psn/transcript.cfm?show=28#4. Accessed Feb 12, 2007
19. American Diabetes Association, American Psychiatric Association, American Association of Clinical Endocrinologists, North American Association for the Study of Obesity. Consensus development conference on antipsychotic drugs and obesity and diabetes. J Clin Psychiatry 2004;65:267–272
20. Marder S, Essock S, Miller AL, et al. Physical health monitoring of patients with schizophrenia. Am J Psychiatry 2004;161:1334–1349
21. Fenton W, Chavez M. Medication-induced weight gain and dyslipidemia in patients with schizophrenia. Am J Psychiatry 2006;163:1697–1704
22. Cohen D, Stolk RP, Grobbee DE, et al. Hyperglycemia and diabetes in patients with schizophrenia or schizoaffective disorders. Diabetes Care 2006;29:786–791
23. Sernyak MJ, Gulanski B, Rosenheck R. Undiagnosed hyperglycemia in patients treated with atypical antipsychotics. J Clin Psychiatry 2005;66:1463–1467
24. Boilson M, Hamilton RJ. A survey of monitoring of weight and blood glucose in in-patients. Psychiatr Bull R Coll Psychiatr 2003;27:424–426
25. Taylor D, Young C, Esop R, et al. Testing for diabetes in hospitalised patients prescribed antipsychotic drugs. Br J Psychiatry 2004;185:152–156
26. Weissman EM, Zhu C, Schooler N, et al. Lipid monitoring in patients with schizophrenia prescribed second-generation antipsychotics. J Clin Psychiatry 2006;67:1323–1326
27. Cuffel B, Martin J, Joyce AT, et al. Lipid and glucose monitoring during atypical antipsychotic treatment: effects of the 2004 ADA/APA Consensus Statement. Presented at the 159th annual meeting of the American Psychiatric Association; May 20–25, 2007; Toronto, Canada
28. Barnes TR, Paton C, Cavanagh MR, et al. A UK audit of screening for the metabolic side effects of antipsychotics in community patients. Schizophr Bull May 4, 2007 [Epub ahead of print]
29. Zuvekas SH. Prescription drugs and the changing patterns of treatment for mental disorders, 1996–2001. Health Aff (Millwood) 2005;24:195–205
30. Frayne S, Halanych J, Miller D, et al. Disparities in diabetes care: impact of mental illness. Arch Intern Med 2005;165:2631–2638
31. American Diabetes Association. Standards of medical care in diabetes—2006. Diabetes Care 2006;29(suppl 1):S4–S42
32. Tang PC, Ralston M, Arrigotti MF, et al. Comparison of methodologies

for calculating quality measures based on administrative data versus clinical data from an electronic health record system: implications for performance measures. J Am Med Inform Assoc 2007;14:10–15
33. American Diabetes Association. Screening for type 2 diabetes. Diabetes Care 2003;26(suppl 1):S21–S24
34. Melkersson KI, Hulting AL, Brismar KE. Different influences of classical antipsychotics and clozapine on glucose-insulin homeostasis in patients with schizophrenia or related psychoses. J Clin Psychiatry 1999;60:783–791
35. Buckley PF, Miller DD, Singer B, et al. Clinicians' recognition of the metabolic adverse effects of antipsychotic medications. Schizophr Res 2005;79:281–288
36. Newcomer JW, Nasrallah HA, Loebel AD. The Atypical Antipsychotic Therapy and Metabolic Issues National Survey: practice patterns and knowledge of psychiatrists. J Clin Psychopharmacol 2004;24 (5 suppl 1):S1–S6
37. Daumit GL, Crum RM, Guallar E, et al. Receipt of preventive medical services at psychiatric visits by patients with severe mental illness. Psychiatr Serv 2002;53:884–887
38. Morrato EH, Newcomer JW, Valuck RJ. Atypical antipsychotics and diabetes testing: a four-state Medicaid study. Diabetes 2006;55(suppl 1): A949
39. National Alliance on Mental Illness. Grading the States: A Report on America's Health Care System for Serious Mental Illness. Arlington, Va: National Alliance on Mental Illness; 2006
40. Svendsen D, Singer PW. Excess mortality and morbidity among persons with severe mental illness: implications for states, NASMHPD, and others. Presented at the Summer 2006 Commissioners Meeting of the National Association of State Mental Health Program Directors (NASMHPD); July 9–11, 2006; Kissimmee, Fla
41. Nasrallah HA, Meyer JM, Goff DC, et al. Low rates of treatment for hypertension, dyslipidemia and diabetes in schizophrenia: data from the CATIE schizophrenia trial sample at baseline. Schizophr Res 2006;86: 15–22
42. Kaiser Foundation. State Medicaid Fact Sheet. Available at: http://www.kff.org/mfs/index.jsp. Accessed May 16, 2006

