Outpatient Antipsychotic Treatment and Inpatient Costs of Schizophrenia

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Objective: To estimate the proportions of acute care inpatient admissions and hospital days for schizophrenia patients in the Medicaid program that are attributable to gaps in outpatient antipsychotic treatment and to calculate the corresponding total health care costs of this care. *Methods:* A series of multivariate regressions were performed with statewide 2001–2003 California Medicaid data to estimate the fraction of acute care hospital admissions and hospital days for schizophrenia attributable to gaps in antipsychotic medication treatment. This fraction was then applied to national estimates of the number and costs of inpatient treatment episodes for patients with schizophrenia in the national Medicaid program. *Results:* In the United States, there are roughly 87 000 annual acute care inpatient admissions of Medicaid patients for the treatment of schizophrenia. These admissions include a total of approximately 930 000 hospital days at a total cost of $806 million. Improving adherence to eliminate gaps in antipsychotic medication treatment could lower the number of acute care admissions by approximately 12.3% (95% confidence interval [CI]: 11.7%–12.6%) and reduce the number of inpatient treatment days by approximately 13.1% (CI: 9.8%–16.5%) resulting in a savings of approximately $106 million (95% CI: $79.0 million–$133.0 million) in inpatient care costs for the national Medicaid system. *Conclusions:* Nonadherence to antipsychotic medication treatment accounts for a considerable proportion of inpatient treatment costs of Medicaid patients with schizophrenia. Improving continuity of antipsychotic medications could lead to savings by reducing the frequency and duration of inpatient treatment.

Key words: schizophrenia/medication adherence/treatment costs

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Introduction

Nonadherence with antipsychotic medications is widely believed to be an important proximal cause of hospital admission in schizophrenia.[1,2] Randomized controlled trials,[3] observational clinical studies,[2,4] and secondary analyses of administrative data[5–8] all suggest that nonadherence with antipsychotic medications increases the risk of hospital admission. In one cohort of patients with chronic schizophrenia, for example, discontinuation of antipsychotic medications approximately doubled the risk of hospital readmission during the first 3 months following hospital discharge.[2]

Despite steady declines in the length of inpatient admissions,[9,10] hospital care continues to comprise a substantial proportion of overall health care costs of persons with schizophrenia. Inpatient mental health treatment has been estimated to account for over one-quarter of total US mental health expenditures.[11] This is approximately 3 times the costs of outpatient psychotropic medications and more than the costs of outpatient services provided by psychiatrists, psychologists, and social workers combined.[11]

The extent to which medication nonadherence contributes to the frequency, duration, and costs of acute care hospital admissions for schizophrenia remain poorly understood.[4,12] In one early study, it was estimated that medication discontinuation accounts for approximately 40% of hospital costs of patients with schizophrenia during a 2-year period following hospital discharge.[3] However, this figure likely overestimates the contribution of medication discontinuation to inpatient costs in community practice because it was based on medication nonadherence estimates from patients during their first few months following hospital discharge. Recently discharged inpatients are known to have an especially high risk of medication discontinuation[13,14] and hospital readmission.[15] The results of this research are further limited because they are based on a summary of results from patients in published clinical trials rather than the experiences of patients receiving community care. Although lower antipsychotic adherence[7] and gaps in antipsychotic treatment[6] have been linked to increased risk of inpatient admission for patients in the community, the relative contribution of gaps in maintenance antipsychotic treatment to the frequency

and duration of acute care inpatient use and costs remains unknown.

Using econometric methods, we analyze the relationship between gaps in antipsychotic medication and hospital admission among California Medicaid (Medi-Cal) recipients treated for schizophrenia in order to estimate the fraction of hospital admissions and hospital days attributable to gaps in antipsychotic medication. These fractions are then applied to national estimates of acute care hospital admissions and costs in the US Medicaid system to derive the national number and cost of acute care inpatient admissions for Medicaid schizophrenia patients that are attributable to gaps in antipsychotic medication treatment.

Methods

Sources of Data

In the United States, Medicaid is the largest payer of community hospital inpatient treatment for schizophrenia.[16] According to the 2004 Healthcare Cost and Utilization Project, Medicaid was the primary payer in 54.5% of community hospital discharges with a principal diagnosis of schizophrenia followed by Medicare (30.0%), private insurance (6.7%), other public insurance (4.7%), and no insurance (4.1%). Because of the prominence of the Medicaid program as a payer of inpatient treatment for schizophrenia, we draw on service use and pharmacy claims from the largest Medicaid program, Medi-Cal (2001–2003)[17] to model associations between gaps in antipsychotic treatment and hospital admission for the treatment of schizophrenia. The data provide information on program enrollment, inpatient and outpatient service use, specific medications prescribed, date of prescription, and number of days of medication supplied. In the current analysis, we focus on prescriptions of oral antipsychotic medications.

Two federal surveys were used to estimate the total national distribution and costs of Medicaid-reimbursed acute care hospital admissions for schizophrenia: (1) the 1997 Client/Patient Sample Survey (CPSS) and (2) the 2002 Survey of Mental Health Organizations and General Hospital Mental Health Services, and Managed Behavioral Health Organizations (SMHO).

The CPSS, which is organized by the Substance Abuse and Mental Health Services Administration (SAMHSA), collects data on the sociodemographic, diagnostic, and service use characteristics of patients in organizations in the United States that treat patients with mental disorders. Within a probability sample of facilities, probability samples are selected of patients admitted during a 1-month period. Patient-level data are weighted to create national estimates of the total number of acute care admissions and lengths of stay during a 1-year period.[10] In 1997, 2738 programs were sampled and 23 415 patients were sampled within these programs.

The SMHO, which is also organized by SAMHSA, is a national survey completed by specialty mental health organizations and nonfederal general hospitals treating patients with mental disorders to determine national costs of treatment episodes in each type of organization. The 2002 SMHO inventory sought information on the patient population and the nature of treatment episodes at each facility in the United States.[18]

Types of organizations surveyed in the CPSS and SMHO include outpatient mental health clinics, psychiatric hospitals (private and public), general hospitals with separate psychiatric services, Veterans Affairs medical centers, federally funded community mental health centers, residential treatment centers, and other mental health organizations including free-standing psychiatric outpatient clinics, free-standing partial care organizations, and multiservice mental health organizations.

Cohort Selection for Medi-Cal Analyses

Medi-Cal recipients between age 18 and 64 years were selected who had received at least 2 outpatient or 1 inpatient claim for schizophrenia (International Classification of Diseases [ICD]: 295).[19] Because of concern over the consistency of the days supplied recorded for long-acting antipsychotic medications,[5,6] patients receiving these preparations were excluded from the analyses. Patients with a diagnosis of bipolar disorder were also excluded from the analyses as were patients who had a hospital admission for schizophrenia that lasted for more than 30 days. We focused on acute care (≤ 30 days) inpatient admissions because they constitute the great majority of inpatient treatment episodes for schizophrenia.[20] In addition, medication discontinuation may be more closely associated with acute inpatient care[21] as compared with long-term inpatient admissions, which are presumably more closely related to treatment-resistant clinical syndromes.[22] Patients under fee-for-service and managed care financing were included in the analysis. However, patients who filled no prescriptions for any medications were excluded from the study cohort. This eligibility criterion, which excluded 1.7% of our patient sample, effectively removed patients within health plans that do not report prescriptions.

Definition of Variables for Medi-Cal Analysis

On the basis of the antipsychotic prescription claims, each patient day in which the patient was eligible for services starting with the first mention of a schizophrenia diagnosis was considered as including either antipsychotic treatment or no treatment. Antipsychotic treatment was assumed to occur on each day with evidence of prescription coverage and for 15 days following the termination of the prescription coverage.[5–7] A sensitivity analysis was conducted with a 30-day gap in the prescription record. Days in which patients were hospitalized, other than the admission day, were excluded from the analysis.

Other day-level independent variables from the Medi-Cal data include recipient age in years (18–25, 26–35, 36–45, 46–64), sex, race (white, black, other), selected comorbid mental disorders as identified by a claim for the treatment of substance use disorders (*ICD-9*: 291, 292, 303–305), anxiety disorders (300.0, 300.2, 300.3, or 308.3), and depressive disorders (296.2, 296.3, 300.4, 311) in the prior 90 days.

Acute care hospital admissions were defined to include all new inpatient care episodes of 30-day duration or shorter in which the primary diagnosis was schizophrenia (295) or the second listed diagnosis was schizophrenia and the primary diagnosis was another mental disorder (290–294, 296–319). In addition, these short-term hospital admissions were partitioned by whether they lasted 1–14 days or 15–30 days to explore the possibility that gaps in antipsychotic treatment influence a hospitalization based on its subsequent length.[23]

Analysis of Medi-Cal Data

We used Medi-Cal data to conduct 5 sets of analyses. The first analysis determined the rate of inpatient admission per 100 000 eligible person-days overall and stratified by patient age-group, sex, and race/ethnicity among the study patients. Second, among inpatient admissions, the proportion with no use of antipsychotic medications in the preceding 15 days was determined overall and stratified by patient age-group, sex, race/ethnicity, comorbid mental disorders, and length of inpatient stay. Rao-Scott chi-square analyses were performed to test for differences in rates across strata for each categorical variable while accounting for the potential clustering of hospitalizations within persons ($\alpha = 0.05$, two tailed). Third, a logistic regression analysis was performed with individual patient days as the unit of observation to assess the effects of antipsychotic medication non-use on hospital admission controlling for demographic and time-varying clinical factors previously described. Due to the computational intensity required to conduct these multivariate logistic models at the day level, we limited the sample in this analysis to all patients with a schizophrenia hospital admission but only a random 5% sample of patients who did not have a hospital admission. Fourth, among the patients who were hospitalized, a linear model was used to assess the effects of antipsychotic nonuse and other factors on the hospital length of stay. The fifth set of analyses used methods of Miller et al[24] to calculate the proportion of acute care hospital admissions and the proportion of hospital days attributable to medication nonuse. Using the beta coefficients from the logistic model above along with the day-level data, we calculate a predicted probability of hospital admission on each day and then sum the probabilities across all days to obtain the total number of observed hospital admissions. We then repeated this process assuming all days

were associated with antipsychotic treatment (ie, the beta coefficient for nonadherence is forced to be 0) and summed the predicted probabilities to obtain the predicted number of admissions assuming antipsychotic treatment. The percentage change between the observed and predicted number of acute care admissions is the population-attributable percentage. Confidence intervals (CIs) around the population-attributable percentage of admissions were calculated by repeating the analysis by summing the upper and lower 95% confidence intervals for the predicted probabilities obtained from the logistic model using maximum likelihood estimates. We then follow the same technique applying the beta coefficients from the linear model for length of stay for each admission. The process was repeated assuming all admissions are preceded by antipsychotic medication use to calculate a predicted length of stay for each admission. The population-attributable percentage of days is computed by calculating the percentage change between the observed and predicted number of days in the population. The observed and predicted number of days is the sum, across all days, of the product of the appropriate predicted probability of admission and the predicted length of stay as calculated above. The confidence interval around the calculated population-attributable percentage of days was obtained by computing SDs of each sum using Taylor series linearization and using those values in a formula proposed by the US Census Bureau to produce confidence intervals around the percentage change.[25]

National Volume and Costs of Acute Care Inpatient Medicaid Admissions

Data from the 1997 CPSS were used to estimate the number of adult inpatient admissions of Medicaid patients with schizophrenia that were 30 days or less in duration and the total number of inpatient days in five types of organizations: state and county mental hospitals, private psychiatric hospitals, nonfederal general hospitals, medical centers operated by the Department of Veterans Affairs, and multiservice mental health organizations. National estimates of the mean daily costs of inpatient psychiatric care were derived from the 2002 SMHO for all payers. Separate estimates from both surveys were determined for each type of organization except multiservice mental health organizations which were imputed on the basis of state and county hospital data. Total inpatient costs were determined by multiplying the total number of Medicaid reimbursed inpatient days for patients with schizophrenia in each facility by the mean daily expenditure for that type of organization. The hospital services component of the Consumer Price Index was used to inflate 2002 dollars to mid-year 2005 dollars (18.1%).[26]

The estimate of national inpatient acute care admissions attributable to gaps in medication use was calculated

Table 1. Rate of Inpatient Treatment for Schizophrenia per 100 000 Eligible Patient-Days Among Outpatients Treated for Schizophrenia (*N* = 35 815)

Group	Sample Size	Eligible Days	Number of Admissions	Rate of Inpatient Admission per 100 000 Person-Days (95% CI)
Total	35 815	23 161 428	1028	4.44 (3.69–5.18)
Age, y				
18–25	3233	1 901 443	134	7.05 (4.19–9.91)
26–35	6731	4 408 470	195	4.42 (3.14–5.71)
36–45	11 897	8 039 998	276	3.43 (2.30–4.56)
46–64	13 954	8 811 517	423	4.80 (3.40–6.20)
Sex				
Male	20 982	13 670 688	563	4.12 (3.13–5.11)
Female	14 833	9 490 740	465	4.90 (3.76–6.40)
Race/ethnicity				
White	18 628	12 374 483	493	4.00 (3.06–4.94)
Black	6375	3 963 816	180	4.54 (2.96–6.13)
Other	10 806	6 820 478	353	5.18 (3.55–6.80)

Note: Data from 2001–2003 Medi-Cal files.

by applying the adjusted population fraction of inpatient admissions attributable to antipsychotic medication nonuse from the Medi-Cal analyses to the number of national acute care inpatient admissions derived from the CPSS. Similarly, the national number of inpatient days attributable to medication nonuse was computed by applying the adjusted population fraction of inpatient days to the national number of inpatient days derived from the CPSS. The total inflation-adjusted inpatient costs were calculated by multiplying the attributable number of inpatient days by the mean daily costs within each type of organization.

Results

Rates of Inpatient Admission

A total of 35 815 patients with schizophrenia were entered into the Medicaid analysis. Approximately 2.2% (*n* = 787) of these patients collectively accounted for 1028 schizophrenia inpatient admissions. The mean length of stay of these admissions was 9.2 days (SD = 7.6 days). Overall, there were 23 161 428 eligible days corresponding to 4.44 inpatient schizophrenia admissions per 100 000 person-days. Although the rate of schizophrenia admissions tended to be higher for younger than older patients, females than males, and members of racial and ethnic minorities than white patients, none of these differences were statistically significant (table 1).

Antipsychotic Treatment Prior to Inpatient Admission

Roughly one-third (36.6%) of acute care inpatient admissions with schizophrenia occurred during gaps, (nonuse days) in the antipsychotic medication prescription record. In the bivariate analysis, patient age, race/ethnicity, comoribid substance use disorder, and length of index

admission were each related to hospital admission during a gap. In the multivariate model, which controlled for patient age, sex, race, treatment of comorbid mental disorders, and length of stay, no treatment with antipsychotic medications within 15 days of the date of hospital admission was significantly more common among black than white patients and patients with as opposed to without comorbid substance use disorders. In addition, patients who were 18–25 years of age were significantly more likely than those who were of age 46–65 years to have a gap in antipsychotic medication use immediately prior to the hospital admission (table 2).

Predictors of Inpatient Admission

In the analyses with days as the unit of observation, after controlling for the potentially confounding effects of patient age, sex, race, and treatment of comorbid anxiety, depressive, and substance use disorders, gaps in antipsychotic medications were associated with a significant increase in the odds of hospital admission (OR = 1.49, 95% CI: 1.27–1.75) (table 3). In this model, comorbid substance use disorder and race/ethnicity other than black or white were each related to acute care inpatient admission.

Attributable Acute Care Admissions and Inpatient Days

Adjusting for background patient characteristics, the fraction of acute care inpatient admissions attributable to not receiving antipsychotic medications was 12.3% (95% CI: 11.7%–12.6%) and the fraction of inpatient days attributable to not receiving antipsychotic medications was 13.1% (95% CI: 9.8%–16.5%) when a 15-day gap in the prescription record was used. When a 30-day gap was used, the attributable rates changed modestly to 9.5% (95% CI: 9.0%–10.0%) of admissions and 10.2% (95% CI: 6.8%–13.7%) of days. In the following

Table 2. Proportion of Acute Care Inpatient Admissions for Patients With Schizophrenia That Occur During a Gap in Antipsychotic Treatment (N = 1028)

Group	Percentage of Admissions During a Gap in Antipsychotics	χ^2	df	P^a	OR (95% CI)^b
Total (N = 1028)	36.6				
Age, y		15.3	9	.002	
18–25 (n = 134)	42.5				(reference)
26–35 (n = 195)	46.7				1.13 (0.69–1.84)
36–45 (n = 276)	37.0				0.77 (0.48–1.23)
46–64 (n = 423)	29.8				0.58 (0.36–0.95)
Sex		0.5	1	0.47	
Male (n = 563)	35.4				(reference)
Female (n = 465)	38.1				1.15 (0.85–1.58)
Race/ethnicity		6.3	2	.044	
White (n = 495)	32.5				(reference)
Black (n = 180)	45.5				1.62 (1.10–2.40)
Other (n = 353)	37.5				1.22 (0.85–1.77)
Treatment of comorbid substance use disorder		10.8	1	.001	
Present (n = 219)	46.6				1.62 (1.10–2.21)
Absent (n = 809)	33.9				(reference)
Treatment of comorbid depressive disorder		0.04	1	.84	
Present (n = 139)	37.4				.91 (0.60–1.38)
Absent (n = 889)	36.4				(reference)
Treatment of comorbid anxiety disorder		0.02	1	.89	
Present (n = 56)	37.5				0.92 (0.50–1.72)
Absent (n = 972)	36.5				(reference)
Length of inpatient stay, days		8.9	1	.003	
1–14 (n = 788)	37.9				(reference)
15–30 (n = 240)	32.1				0.88 (0.63–1.23)

Note: Data from 2001–2003 Medi-Cal files. Gap in antipsychotic treatment defined as a period of longer than fifteen days beyond the end of the last supplied antipsychotic medications.
^{a}The P values are derived from bivariate analyses.
^{b}Odds ratios (ORs) are derived from a multivariable analysis of a single logistic model with antipsychotic gap as the dependent variable and the variables in all rows as independent variables.

analyses, we apply the 15-day gap figures to the national estimates.

Hospital Admissions

According to the 1997 CPSS, there are an estimated 86 878 annual acute care hospital admissions and total 930 062 inpatient days provided to Medicaid-financed patients for the treatment of schizophrenia in the United States. Nearly three-quarters (74.6%) of these admissions were to nonfederal general hospitals. The remainder of the admissions was distributed among multiservice mental health organizations (12.1%), private psychiatric hospitals (10.5%), state and county mental hospitals (2.8%), and medical centers operated by the Department of Veterans Affairs (0.01%).

The total cost of these inpatient admissions is approximately $806 million. This estimate is derived by applying the 2002 SMHO mean daily costs of inpatient treatment for each organization, adjusted for inflation, to the estimated number of inpatient days in that organization.

Applying the adjusted attributable fraction of inpatient admissions due to gaps in antipsychotic treatment (12.3%, 95% CI: 11.7%–12.6%) to the national estimate of admissions yields 10 686 (95% CI: 10 165–10 947) annual acute care hospital admissions attributable to gaps in antipsychotic treatment. Applying the adjusted attributable fraction of inpatient days (13.1%, 95% CI: 9.8%–16.5%) yields 121 838 inpatient days and an inpatient cost of approximately $106 million (95% CI: $79.0 million–$133.0 million) attributed to gaps in treatment.

Discussion

During the course of 1 year, there are roughly 87 000 acute care inpatient admissions of patients with schizophrenia in the Medicaid program. The cost of these admissions is approximately $800 million. At the time of admission, we estimate that roughly 30 000 or slightly more than one-third of the acute care admissions for schizophrenia are not being treated with antipsychotic

Table 3. Predictors of Inpatient Admission and Length of Stay for the Treatment of Schizophrenia at the Day Level

Predictor	Admissions, OR (95% CI) (N = 1028 Admissions)	Length of Stay β, P (N = 1 292 697 Days)
Nonuse of anitpsychotics	1.49 (1.27–1.75)	−0.51, P = .31
Comorbid mental disorders		
Substance use disorder (absent)	3.61 (2.96–4.41)	−3.73, P < .0001
Anxiety disorder (absent)	1.27 (0.94–1.73)	−2.09, P = .02
Depressive disorder (absent)	1.26 (.98–1.61)	−2.87, P < .0001
Race (white)		
Black	1.04 (.82–1.31)	−1.76, P = .02
Other	1.30 (1.02–1.66)	−0.29, P = .68
Sex (male)		
Female	1.16 (.94–1.42)	−0.72, P = .29
Age (y)	1.00 (.99–1.01)	0.02, P = .47

Note: Data from 2001–2003 Medi-Cal files. Results of admissions analysis in the first data column are presented as odds ratios (OR) and confidence intervals (CIs) from a logistic regression with inpatient admission for acute care hospital treatment of schizophrenia as the dependent variable. Results of length of stay analysis in the second data column are beta (β) coefficients and associated *P* values from a linear regression of hospital admission days with length of inpatient stay as the dependent variable. Reference groups are listed in parentheses. The adjusted population-attributable fraction of admissions related to gaps in antipsychotic treatment was 12.1%, and the attributable fraction of inpatient days related to gaps in medication was 13.1%. See text for derivation of attributable fractions.

medications. We further estimate that for a substantial number of these admissions gaps in antipsychotic medication, rather than other patient characteristics, account for the inpatient admission. Consistent use of antipsychotic treatment could result in a savings of approximately $106 million in acute care inpatient Medicaid care costs. Continuous use of antipsychotic medications could also decrease the costs of emergency department services, crisis care, and other relapse-related mental health services in the community treatment of schizophrenia.[27]

The proportion of acute care inpatient admissions that were preceded by antipsychotic medication nonuse (36.6%) is in the low end of the range of previously reported rates (28%–72%) using a variety of different measures of medication nonuse.[21,28,29] High rates of medication nonuse or nonadherence prior to inpatient admission highlight problems in the continuity of pharmacological treatment. In practice, clinicians may not be aware of patient problems in this area. In 1 study, the medication electronic monitoring system, which is a cap that detects each pill bottle opening, detected significant

antipsychotic medication non-adherence in 12 of 25 schizophrenia patients while clinicians detected non-adherence in none of the patients.[30]

Inpatient episodes occurring during treatment continuity gaps were especially evident for patients with substance use disorders. It is possible that deficits in self-care, disruptive behaviors, housing instability, financial crises, and other functional disturbances related to substance use help to explain the connection between substance use and antipsychotic nonadherence among inpatient admissions.[31–33] Treatment of these comorbid substance use disorders and careful outpatient vigilance of treatment continuity in minority populations might reduce gaps in antipsychotic medication treatment, subsequent hospital admissions, and cost of care.

Among admitted patients, those who were treated for comorbid substance use, depressive, or anxiety disorders prior to their inpatient admission tended to have significantly shorter inpatient stays than patients who had not been treated for these comorbid disorders. Although the clinical basis for these differences in length of stay is unknown, comorbid substance use disorders have been previously associated with shorter inpatient treatment of schizophrenia.[34,35] It has been hypothesized that substance use may temporarily amplify symptoms of schizophrenia in a manner that permits faster stabilization during short-term admission.[36] It is conceivable that comorbid anxiety and depressive disorders function in a similar manner.

The medication possession ratio is the most commonly used method for measuring medication use in research with administrative claims data.[5–8] Each subject is assigned a ratio of the total number of days supplied of medication to the number of days during the study period. A limitation of this approach is that it does not measure medication availability at a fixed point in time.[35] By contrast, the method employed in the current study captures short-term variations in medication availability and thereby provides a means of temporally examining the effect of medication availability on the risk of hospital admission.

The study findings should be viewed in the context of several methodological limitations. First, although pharmacy claims measure psychotropic medication utilization with reasonable accuracy,[36,37] prescription records are only a proxy for actual pill-taking behavior. A direct measure of medication use would have been preferable to relying on prescription billing records. Slightly different results were obtained when the medication gap was selected at 30 rather than 15 days in medication supply. Second, we assume that all patients with schizophrenia not prescribed antipsychotic medications are "medication nonadherent." However, some patients with schizophrenia are not prescribed antipsychotic medications,[38] and others may be experiencing side effects or other tolerability issues that have not been addressed. For these

patients, the issue may be better characterized as medication availability than adherence or continuation. Third, Medicaid data provide no information concerning several factors, such as illness awareness, the therapeutic alliance, family support, or monitoring of medications that may exert influence on medication availability. Fourth, the analyses were limited to acute care hospitalizations and may not generalize to long-term admissions. Longer inpatient admissions presumably tend to involve patients who remain symptomatic despite various medication trials and may not therefore bear the same relationships to medication nonadherence. Fifth, the analysis assumes that Medicaid patients in California share similar patterns of medication treatment and hospital admission with patients from other state Medicaid programs. California accounts for a substantial proportion (14.4%) of all Medicaid enrollees[39] and ranks in the middle (twenty-fifth) among states in per capita Medicaid spending,[40] though it has a relatively low per capita rate of mental health inpatient admissions.[41] A recent assessment conducted by the National Alliance on Mental Illness determined that the California state system together with 36 other state systems have moderate problems with access to psychiatric inpatient care.[42] This suggests that the quality of schizophrenia treatment and use of inpatient services under Medi-Cal broadly resembles patterns across the state Medicaid programs and supports the use of Medi-Cal patients as a proxy for the national Medicaid experience. However, little is known about the narrower issue of state-to-state variation in relationships between antipsychotic nonadherence and inpatient admission among schizophrenia patients in the Medicaid program. Sixth, our cost estimates further assume that the duration and volume of acute care hospital admissions for schizophrenia have remained relatively constant since 1997. The average length of stay in US short-stay nonfederal hospitals for discharges with a first listed diagnosis of schizophrenia declined slightly between 1997 (11.9 days) and 2004 (10.8 days), while the number of schizophrenia discharges has increased from 262 000 in 1997 to 331 000 in 2004.[43,44] Seventh, the Taylor series confidence intervals surrounding the total inpatient costs associated with gaps in antipsychotic treatment may underestimate the extent of uncertainty because they do not fully incorporate the effects of the admissions' estimate on the days estimate and, furthermore, no error estimates are available from the national survey data or the Consumer Price Index. Finally, the Medi-Cal analyses but not the national projections exclude the small proportion of schizophrenia patients receiving depot antipsychotic medications. Depot is a widely recognized pharmacological approach to the treatment of medications nonadherence in schizophrenia.[45]

Gaps in antipsychotic medication treatment appear to make a meaningful contribution to the national costs of acute care inpatient treatment of schizophrenia patients in the Medicaid program. Enhancing continuity of antipsychotic treatment, through improvements in behavioral and psychosocial interventions, medication tolerability, and drug delivery systems, has the potential to reduce the economic as well as the human costs of relapse and hospital admission in schizophrenia.

Acknowledgments

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