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Serious Mental Illness and Medical Comorbidities: Findings from an Integrated Health Care System

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Abstract

Objective—To examine the odds associated with having medical comorbidities among patients with serious mental illness (SMI) in a large integrated health system.

Method—In a secondary analysis of electronic health record data, this study identified 25,090 patients with an ICD-9 SMI diagnosis of bipolar disorder (n = 20,308) or schizophrenia (n = 4,782) and 25,090 controls who did not have a SMI, matched on age, gender, and medical home facility. Conditional logistic regressions compared the odds associated with having nine medical comorbidity categories and fifteen chronic or serious conditions among patients with SMI versus controls.

Results—Results showed having a SMI was associated with significantly higher odds of each medical comorbidity examined (p's < .001), except no evidence of a significant association was found between having schizophrenia and musculoskeletal diseases. A similar pattern was found regarding the chronic or severe conditions, where having schizophrenia or bipolar was associated with >1.5 times the odds of each condition (p's < .001).

Conclusions—In an integrated health system where patients may have fewer barriers to care, SMI patients are likely to present for treatment with a range of medical comorbidities, including chronic and severe conditions. SMI patients may need outreach strategies focused on disease prevention, screening and early diagnosis, and treatment to address medical comorbidities and associated poor health outcomes.

Keywords

serious mental illness; health systems; chronic conditions; medical comorbidity

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Conflicts of Interest

None of the authors reported a conflict of interest with respect to this project.

INTRODUCTION

Serious mental illnesses (SMI), which typically include bipolar disorders and schizophrenia, are characterized as chronic and debilitating conditions that place significant burdens on patients, as well as their families and society. Despite the marked improvement in managing destabilizing symptoms that followed the introduction of psychotropic medications,[1] most patients who suffer from a SMI continue to have a limited recovery and experience poor physical health.[2–5] Fifty to 80%[6–8] of individuals with SMI have one or more comorbid medical conditions that may worsen prognosis and contribute to high morbidity and premature mortality.[3,9–10] More concerning is that over 60% of the medical comorbidities observed among persons with SMIs are non-fatal and preventable, yet these persons have 15 to 25 years shorter expectancy relative to the general population.[11] Unfortunately, the medical needs of those with SMI are often neglected,[12] which may partly explain the reason for why their morbidity and mortality are elevated.

Studies of modifiable risk factors suggest that risky sexual behaviors and poor hygiene,[13,14] are linked with higher risk of genitourinary, infectious, and blood borne diseases among individuals with SMIs. Increased rates of alcohol and illicit drug use,[13] smoking,[14–17] poor nutrition and lack of exercise,[18] may be associated with higher rates of cardiovascular and respiratory [8,10,13,15,19] conditions; and genitourinary and metabolic[8,10,13,16,19–20] diseases. Patients with SMI also present for treatment with a number of serious and chronic medical conditions (i.e., hypertension, asthma, obesity, chronic obstructive pulmonary disease, epilepsy),[2,4,21] and these conditions can onset up to 10 years earlier in this population compared to age-matched controls.[22] In addition, having medical comorbidities place SMI patients at risk of repeat hospital visits that raise health care costs and increase the burden of disease.[4,23–24] Not surprisingly, the problem of medical comorbidities in SMI is now considered a major public health issue due to its destabilizing effects and high cost to families and society.[12]

Patients with SMI continue to experience elevated morbidity despite the identification of several preventable and modifiable risk factors for poor health. Thus, a study that seeks to examine associations among patients with SMI and odds of having medical comorbidities in a large integrated health system is important to inform patient care. In this study, we examined associations among 25,090 patients with a SMI diagnosis of bipolar disorder or schizophrenia and odds of having medical comorbidities relative to 25,090 patients without an SMI in a large health system. Importantly, to inform patient care planning we examined acute conditions, which are more likely to require immediate medical attention as well as severe or chronic conditions necessitating ongoing monitoring and management.

METHODS

Setting

Kaiser Permanente of Northern California (KPNC) is a nonprofit, integrated health care delivery system providing health care services to more than 4 million members, serving 45% of the commercially insured population in the region. KPNC consists of a health care plan, a

sole medical group, and a hospital system. Specialty health services, such as psychiatry, substance use treatment, and other specialty care, are available to all members internally. To facilitate integrated health care services, providers have access to a mature electronic health record (EHR) system with each member's medical history, including primary care, emergency department, ambulatory, hospital and specialty health care encounters. In KPNC, about 88% of members are commercially insured, 28% have Medicare and 10% have Medicaid coverage. All patients were selected from the KPNC membership for this study. Institutional review board approval was obtained from the Kaiser Foundation Research Institute.

Participants

We used EHR data for this secondary, database study. These data were used to identify all health system members who 1) were at least 18 years of age, 2) had a visit to a KPNC facility in 2010, and 3) had a recorded ICD-9 diagnosis of schizophrenia or bipolar disorder in 2010. The first mention of each ICD-9 diagnosis of schizophrenia or bipolar recorded from January 1, 2010 to December 2010 were included; patients in the sample could have multiple diagnoses (e.g., the SMI groups were not mutually exclusive). We also included all current or existing behavioral health diagnoses that were additionally documented for patients with schizophrenia or bipolar during health system visits in 2010 (see Appendix A for a complete list of ICD-9 codes).

EHR data were also used to identify control patients without current or existing behavioral health diagnoses. Control patients were selected for all unique patients with bipolar disorder or schizophrenia, and matched one-to-one on gender, age, and medical home facility (e.g., the medical center where they typically receive care). This method accounted for any differences in services, types of conditions, or unobservable differences by geographic location.

The final analytical sample consisted of 50,180 patients: 20,308 with bipolar disorder, 4,782 with schizophrenia, and 25, 090 controls. Institutional review board approval was obtained from the Kaiser Foundation Research Institute.

Measures

Patient characteristics—Age, gender, race/ethnicity, patient medical home facility, census based median neighborhood household income, and ICD-9 psychiatric and medical diagnoses were extracted from the EHR. Race/ethnicity consisted of five categories: white, Black, Hispanic, Asian, and other. Psychiatric and medical diagnoses were determined based on ICD-9 diagnoses noted during visits made over the study period and included current and existing diagnoses.

Medical Comorbidities—Medical ICD-9 diagnoses were extracted from the EHR for nine disease categories previously classified as common in SMI populations based on prior research.[2–5,13–14] Dichotomous measures (1 = present; 0 = else) were computed for the nine medical conditions: diseases of the blood/blood and forming organs; diseases of the circulatory system; diseases of the digestive system; endocrine/immunity diseases;

genitourinary diseases; infectious/parasitic diseases; diseases of the musculoskeletal system; diseases of the nervous system; and diseases of the respiratory system (see Appendix A).

Severe or chronic medical conditions—Using the EHR, we extracted fifteen ICD-9 disease categories for the severe or chronic medical conditions that are considered prevalent in SMI populations based on prior research.[2,4,8,21] Dichotomous measures (1 = present; 0 = else) were computed for each severe/chronic medical condition: acid-peptic disorders; arthritis; asthma; chronic kidney disease; chronic pain; chronic obstructive pulmonary disease; coronary atherosclerosis; diabetes mellitus; hepatitis C; hypertension; injury poisoning/overdose; ischemic heart disease; pneumonia; obesity; and stroke. An indicator (any severe/chronic medical condition: 1 = present; 0 = else) identified those with ≥1 of the fifteen chronic conditions.

Analyses

Frequencies and means were used to characterize the sample. We used McNemar's test (categorical) and paired sample *t*-tests (continuous) to determine potential differences between the matched samples of patients with SMI and controls. These analyses proceeded by examining potential differences between patients with SMI (e.g., bipolar and schizophrenia) compared to controls by age, gender, race/ethnicity and income. A series of conditional logistic regressions were then computed, predicting each of nine medical condition categories (1 = present; 0 = else) from bipolar or schizophrenia (reference = controls), to compare the odds associated with having medical comorbidities in patients with SMI compared to controls. We then computed a series of conditional logistic regressions predicting each of fifteen chronic or severe medical conditions (1 = present; 0 = else) from having bipolar or schizophrenia (reference = controls), to compare the odds of having chronic or severe medical comorbidities in SMI patients versus controls. All conditional logistic regressions adjusted for race/ethnicity and income. SMI and control samples were matched 1-to-1 on age and gender; and thus, no significant differences were anticipated or found between matched groups regarding these relationships (all $p = 1.00$). Conditional logistic regressions were computed without controlling for age or gender. The Hochberg[25] method was used to adjust for multiple inference testing within each medical condition category. We report Hochberg adjusted *p*-values for the conditional logistic regressions comparing the odds of having medical comorbidities for patients with SMI and controls. Statistical significance was defined at $p < .05$; analyses were performed using R version 2.15.0.[26]

RESULTS

Patient characteristics

Overall, the sample was 70.0% women, 60.0% White, 15.6% Hispanic, 12.2% Asian, 7.4% Black, 4.8% other race/ethnicity. Patients were 49 years old on average, (not shown). As shown in Table 1, more patients with schizophrenia or bipolar were white compared to controls; fewer controls were Hispanic, Asian, or Black relative to patients with schizophrenia or bipolar. However, more patients with schizophrenia were Black relative controls. On average, patients with bipolar or schizophrenia lived in lower income

neighborhoods compared to controls. Since patients were matched on age and gender, no evidence of differences across these measures were found among the controls and the patients with schizophrenia or bipolar (Table 1).

Medical comorbidities and chronic medical conditions

As shown in Table 2, having a SMI was largely associated with higher odds of medical comorbidities, with few exceptions. Having bipolar was associated with higher odds of blood/blood forming organ diseases (OR = 2.21, $p < .001$), digestive system diseases (OR = 2.22, $p < .001$), and endocrine/immunity diseases (OR = 2.34, $p < .001$), compared to controls. Likewise, schizophrenia was associated with >2 times the odds of diseases of the blood/blood forming organs (OR = 2.21, $p < .001$), digestive system diseases (OR = 2.22, $p < .001$), and (OR = 2.97, $p < .001$) and endocrine/immunity diseases. Schizophrenia and bipolar were both associated with >1.5 times the odds of diseases of the circulatory, respiratory, and nervous systems as well as infectious/parasitic and genitourinary diseases. Bipolar was also associated with >1.5 times the odds of musculoskeletal diseases; however, no evidence of a significant difference was found between having schizophrenia and musculoskeletal diseases (Table 2).

Table 3 presents results of conditional logistic regressions comparing the odds associated with having a SMI and severe or chronic medical conditions. A diagnosis of bipolar disorder or schizophrenia were both associated with higher odds of ≥1 severe or chronic medical conditions. Having bipolar was associated with >4 times the odds of chronic pain (OR = 4.77, $p < .001$) and hepatitis C (OR = 4.08, $p < .001$). Likewise, schizophrenia was associated with >4 times the odds of chronic pain (OR = 4.10, $p < .001$) and hepatitis C (OR = 4.65, $p < .001$). Additionally, patients with bipolar were >2 times more likely to have eight other severe or chronic conditions (OR range = 2.58—2.05, $p's < .001$) compared to controls including acid peptic, asthma, chronic kidney disease, COPD, injury/poisoning and overdose, pneumonia, obesity, and stroke. Patients with schizophrenia were >2 times more likely to have 6 other severe or chronic conditions (OR range = 3.15—2.10, $p's < .001$) including acid peptic, COPD, diabetes, pneumonia, obesity, and stroke. Bipolar and schizophrenia were both associated with >1.5 times the odds of four chronic or severe conditions including hypertension, ischemic heart disease, arthritis, and coronary atherosclerosis (Table 3).

DISCUSSION

The high prevalence of medical comorbidities among patients with SMI constitutes major clinical and public health problems that have not been adequately addressed in specialty mental health programs or by mainstream health care.[12] This issue is further compounded in individuals who have a SMI by problems associated with substandard living conditions and lack of access to routine health care services, which increase the risk of having unidentified and untreated medical conditions.[2,23–24] Lack of preventative health care in combination with high risk health behaviors among individuals with SMI place them at increased risk of several serious and chronic medical conditions.[2,4,8,21] Patients with SMI remain at risk for elevated morbidity and mortality, despite that health care reform in the U.S. has increased

health care service access for this population in recent years.[12] Given the increased likelihood for individuals with SMI to have poor health and poor health outcomes despite policy and clinical intervention, obtaining current information on the degree to which having a SMI is associated with a range of medical comorbidities from large health systems which manage these persons is critical to tailor future disease prevention efforts, early diagnosis, and treatment to their needs.

To inform patient care and service planning, we examined acute and chronic medical conditions in SMI patients in a large integrated health system, where SMI patients potentially may have better access to health services than in health care systems where services are not integrated.[27] Prior to our primary analyses, we investigated potential socio-economic differences between controls and SMI patients. Since patients with SMI and the controls were matched by age and gender no differences were anticipated or found regarding these characteristics. Patients with SMI tended to be white relative to controls, except that more patients with schizophrenia were Black. Higher rates of Black patients with schizophrenia is largely consistent with prior research,[30–32] and may be in part due to the over-diagnosis of Black persons with this disorder.[33] Also consistent with prior work, we found more SMI patients were located in lower-income neighborhood KPNC service areas than controls.[12] Prior work has found poor socioeconomic status can dramatically limit access to health care and increase exposure to unhealthy behaviors and lifestyles.[2] This phenomenon may partly explain the reason for why having a SMI was disproportionately associated with higher likelihood of having almost all medical comorbidities and serious or chronic conditions examined relative to controls. Notably, while all controls and patients with a SMI had broad access to a range of health services (e.g., primary care, specialty behavioral health services, emergency department, etc.,), lower income for patients with SMI may disproportionately affect their ability to support transportation costs for health system visits and follow-up preventive care, and impact health outcomes. It will be important for future work to more fully examine the role of income in predicting health care access and associated health outcomes in the SMI population. Perhaps in part related to access and low SES, our findings also revealed the odds associated with having acute and chronic medical conditions may not be the same for everyone with a SMI.

Even given differences in study design, types of health care systems and samples studied, our results were largely consistent with prior work that has found patients with schizophrenia are at high risk of having endocrine or immune diseases.[2,8,10,13,15,16,34,35] Patients with schizophrenia were more likely to have endocrine or immunity diseases, as well as diabetes and obesity. While we could not address causal relationships (e.g., whether schizophrenia preceded the onset of diabetes or obesity) with our design, the odds associated with having schizophrenia to obesity and diabetes has been linked to the use of some second-generation antipsychotic medications.[36,37] This is problematic and concerning, as the long-term use of second-generation antipsychotic medications combined with obesity and adverse lifestyle behavior (i.e., poor diet, smoking, illicit drug use, and physical inactivity) have been linked with higher odds of serious cardiovascular events in patients with schizophrenia and other SMI patient groups.[38–40] These phenomena may potentially explain the reason for why we found that having schizophrenia was associated with higher odds of having a serious cardiovascular event, such as stroke. Future longitudinal work in

this area is warranted, and will need to focus on isolating predisposing conditions and other risk factors associated with future cardiovascular events and mortality in schizophrenia.

Although far in excess of control patients, the prevalence of cardiovascular disease and predisposing conditions such as diabetes, hypertension, and obesity in our bipolar sample was slightly below prior reports.[21] Nevertheless, having bipolar was still associated with higher odds of conditions predisposing cardiovascular disease. Notably, these findings may in part explain the reason for why we also found having bipolar was associated with higher likelihood of serious cardiovascular events, including stroke. These findings are of interest because cardiovascular mortality is a leading cause of elevated mortality in patients with bipolar, and is well above the risk associated with un-natural causes of death such as injury and suicide.[21] Consequently, future work in this area is warranted, and will need to determine the risk of cardiovascular disease to future cardiovascular events and cardiovascular mortality in bipolar, as well as whether the rates of cardiovascular mortality may be lower in patients with bipolar in integrated health systems than the general population and other health care systems.

Overall, having bipolar and schizophrenia was associated with high odds of blood borne and infectious disease and of hepatitis C. Although we did not examine routes of transmission, injection drug use, high risk sexual behaviors, or comorbid substance use, SMI patients have been found to exhibit this behavior, raising the odds of blood borne and infectious disease and hepatitis C.[43,44] While substantially higher than the control estimates, the prevalence of hepatitis C in our sample fell below previously published rates of hepatitis C in individuals with SMI.[44] Hepatitis C and HIV risk are often examined at the same time; yet, we could not estimate HIV risk due to low base rates.

Limitations should be noted. Our SMI sample was comprised of patients with bipolar or schizophrenia, and did not include certain psychiatric disorders sometimes regarded as SMI, such as major depression. While our sample was larger than prior studies of medical comorbidities in SMI, it largely consisted of insured members in an integrated health care system and results may not be generalizable to other SMI populations or other types of health systems. Our use of provider-assigned diagnoses restricted our sample to ICD-9 codes assigned during health plan visits. This method is vulnerable to diagnostic under-estimation;[45] and thus, the rates of bipolar and schizophrenia may be somewhat higher than we report. Another potential limitation with the methods used to select the sample is that we required a single mention of an ICD-9 code for SMI during the study period to link the patient with that diagnosis and included all current and existing diagnoses (e.g., could have multiple diagnoses). While this single mention methodology is well established,[45–49] it could result in overestimation if diagnoses only mentioned one time in the EHR are more likely to be inaccurate. Since patients with bipolar or schizophrenia could have multiple behavioral diagnoses. Thus, our results should be interpreted with caution until confirmatory studies are conducted in mutually exclusive SMI groups. All data are cross-sectional; and thus, no directionality can be assumed in associations between conditions, and associations do not imply cause-and-effect relationships. Long-term follow-up studies will be required to capture the full impact medical comorbidities have on the course and outcome of individuals with SMI.

The reasons why having SMI is associated with disproportionately high odds of having medical comorbidities are complex and multi-factorial and future studies will need to continue to monitor medical comorbidity in this population as health policies evolve. We found having a SMI was associated with higher odds of having several medical comorbidities as well as chronic and severe medical conditions, even in an integrated health care system where patients have insurance coverage and broad access to care. Our results suggest that that SMI patients have high medical needs, and implementing enhanced outreach efforts focused on prevention, early diagnosis, and treatment of medical comorbidities may help reduce associated morbidity and mortality and improve overall prognosis in this population.

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Appendix A. Substance Use Disorder; Psychiatric and Medical Condition Diagnoses and Internal Classification of Diseases, Ninth Revision Codes

ICD-9Code	Substance use disorder
291	Alcohol-induced mental disorders

ICD-9Code	Substance use disorder
291.0	Alcohol withdrawal delirium
291.2	Alcohol-induced persisting amnestic disorder
291.3	Alcohol-induced psychotic disorder with hallucinations
291.4	Idiosyncratic alcohol intoxication
291.5	Alcohol-induced psychotic disorder with delusions
291.8	Other specified alcohol-induced mental disorders
291.81	Alcohol withdrawal
291.82	Alcohol-induced sleep disorders
291.89	Other alcohol-induced mental disorders
291.9	Unspecified alcohol-induced mental disorders
292	Drug-induced mental disorders
292.0	Drug withdrawal
292.1	Drug-induced psychotic disorders
292.11	Drug-induced psychotic disorder with delusions
292.12	Drug-induced psychotic disorder with hallucinations
292.2	Pathological drug intoxication
292.8	Other specified drug-induced mental disorders
292.81	Drug-induced delirium
292.82	Drug-induced persisting dementia
292.83	Drug-induced persisting amnestic disorder
292.84	Drug-induced mood disorder
292.85	Drug-induced sleep disorders
292.89	Other specified drug-induced mental disorders
292.9	Unspecified drug-induced mental disorder
303	Alcohol dependence syndrome
303.0	Acute alcoholic intoxication
303.00	Acute intoxication in alcoholism, unspecified
303.01	Acute intoxication in alcoholism, continuous
303.02	Acute intoxication in alcoholism, episodic
303.03	Acute alcoholic intoxication in alcoholism, in remission
303.9	Other and unspecified alcohol dependence
303.90	Other and unspecified alcohol dependence, unspecified
303.91	Other and unspecified alcohol dependence, continuous
303.92	Other and unspecified alcohol dependence, episodic
303.93	Other and unspecified alcohol dependence, in remission
304	Drug dependence
304.0	Opioid-type dependence
304.00	Opioid-type dependence, unspecified
304.01	Opioid-type dependence, continuous
304.02	Opioid-type dependence, episodic
304.03	Opioid-type dependence, in remission
304.1	Sedative, hypnotic or anxiolytic dependence

ICD-9Code	Substance use disorder
304.10	Sedative, hypnotic or anxiolytic dependence, unspecified
304.11	Sedative, hypnotic or anxiolytic dependence, continuous
304.12	Sedative, hypnotic or anxiolytic dependence, episodic
304.13	Sedative, hypnotic or anxiolytic dependence, in remission
304.2	Cocaine dependence
304.20	Cocaine dependence, unspecified
304.21	Cocaine dependence, continuous
304.22	Cocaine dependence, episodic
304.23	Cocaine dependence, in remission
304.3	Cannabis dependence
304.30	Cannabis dependence, unspecified
304.31	Cannabis dependence, continuous
304.32	Cannabis dependence, episodic
304.33	Cannabis dependence, in remission
304.4	Amphetamine and other psychostimulant dependence
304.40	Amphetamine and other psychostimulant dependence, unspecified
304.41	Amphetamine and other psychostimulant dependence, continuous
304.42	Amphetamine and other psychostimulant dependence, episodic
304.43	Amphetamine and other psychostimulant dependence, in remission
304.5	Hallucinogen dependence
304.50	Hallucinogen dependence, unspecified
304.51	Hallucinogen dependence, continuous
304.52	Hallucinogen dependence, episodic
304.53	Hallucinogen dependence, in remission
304.6	Other specified drug dependence
304.60	Other specified drug dependence, unspecified
304.61	Other specified drug dependence, continuous
304.62	Other specified drug dependence, episodic
304.63	Other specified drug dependence, in remission
304.7	Combinations of opioid-type drug with any other drug dependence
304.70	Combinations of opioid-type drug with any other drug dependence, unspecified
304.71	Combinations of opioid-type drug with any other drug dependence, continuous
304.72	Combinations of opioid-type drug with any other drug dependence, episodic
304.73	Combinations of opioid-type drug with any other drug dependence, in remission
304.8	Combinations of drug dependence excluding opioid-type drug
304.80	Combinations of drug dependence excluding opioid-type drug, unspecified
304.81	Combinations of drug dependence excluding opioid-type drug, continuous
304.82	Combinations of drug dependence excluding opioid-type drug, episodic
304.83	Combinations of drug dependence excluding opioid-type drug, in remission
304.9	Unspecified drug dependence
304.90	Unspecified drug dependence, unspecified
304.91	Unspecified drug dependence, continuous

ICD-9Code	Substance use disorder
304.92	Unspecified drug dependence, episodic
304.93	Unspecified drug dependence, in remission
305	Nondependent abuse of drugs
305.0	Nondependent alcohol abuse
305.00	Alcohol abuse, unspecified
305.01	Alcohol abuse, continuous
305.02	Alcohol abuse, episodic
305.03	Alcohol abuse, in remission
305.2	Nondependent cannabis abuse
305.20	Cannabis abuse, unspecified
305.21	Cannabis abuse, continuous
305.22	Cannabis abuse, episodic
305.23	Cannabis abuse, in remission
305.3	Nondependent hallucinogen abuse
305.30	Hallucinogen abuse, unspecified
305.31	Hallucinogen abuse, continuous
305.32	Hallucinogen abuse, episodic
305.33	Hallucinogen abuse, in remission
305.4	Nondependent sedative, hypnotic or anxiolytic abuse
305.40	Sedative, hypnotic or anxiolytic abuse, unspecified
305.41	Sedative, hypnotic or anxiolytic abuse, continuous
305.42	Sedative, hypnotic or anxiolytic abuse, episodic
305.43	Sedative, hypnotic or anxiolytic abuse, in remission
305.5	Nondependent opioid abuse
305.50	Opioid abuse, unspecified
305.51	Opioid abuse, continuous
305.52	Opioid abuse, episodic
305.53	Opioid abuse, in remission
305.6	Nondependent cocaine abuse
305.60	Cocaine abuse, unspecified
305.61	Cocaine abuse, continuous
305.62	Cocaine abuse, episodic
305.63	Cocaine abuse, in remission
305.7	Nondependent amphetamine or related acting sympathomimetic abuse
305.71	Amphetamine or related acting sympathomimetic abuse, unspecified
305.72	Amphetamine or related acting sympathomimetic abuse, continuous
305.73	Amphetamine or related acting sympathomimetic abuse, episodic
305.8	Nondependent antidepressant-type abuse
305.80	Antidepressant-type abuse, unspecified
305.82	Antidepressant-type abuse, continuous
305.83	Antidepressant-type abuse, episodic
305.9	Nondependent other mixed or unspecified drug abuse

ICD-9Code	Substance use disorder
305.90	Other, mixed, or unspecified drug abuse, unspecified
305.91	Other, mixed, or unspecified drug abuse, continuous
305.92	Other, mixed, or unspecified drug abuse, episodic
305.93	Other, mixed, or unspecified drug abuse, in remission
ICD-9 Code	Medical Condition
530–534	Acid-peptic disorders
710–719	Arthritis
493	Asthma
585.9, 403, or 585.1–585.5	Chronic kidney disease
490–492	Chronic obstructive pulmonary disease
338.2	Chronic pain
402.01, 402.11, 402.91, 404.01, 404.11, or 428	Congestive heart failure
440, 429.2, 410–414	Coronary Atherosclerosis
250	Diabetes mellitus
585.6	End-stage renal disease
339, 784.0, or 346	Headaches
0.07.70, 080.74, or 070.75	Hepatitis C
401–405	Hypertension
800–999	Injuries, poisonings, and overdoses
410–414	Ischemic heart disease
278	Obesity
733.3	Osteoporosis
770, 480–486	Pneumonia
345	Stroke
ICD-9 Code	Psychiatric Condition
300.00	Anxiety disorder NOS
300.01	Panic disorder without agoraphobia
300.02	Generalized anxiety disorder
300.2	Phobia, unspecified
300.21	Panic disorder with agoraphobia
300.22	Agoraphobia without history of panic disorder
300.23	Social phobia (social anxiety)
300.29	Specific phobia
300.3	Obsessive compulsive disorder

ICD-9Code	Substance use disorder
309.20	Adjustment disorders with anxiety
309.21	Separation anxiety disorder
309.24	Adjustment disorder with anxiety
309.81	Posttraumatic stress disorder
308.3	Acute stress disorder
314.00	Attention deficit disorder, inattentive type
314.01	Attention deficit disorder, hyperactive/impulsive or combined type
314.1	Hyperkinesis with developmental delay
314.2	Hyperkinetic conduct disorder of childhood
314.8	Other specific manifests hyperkinetic syndrome, child
314.9	Attention deficit disorder NOS
299.01	Autistic disorder, residual state
299.10	Childhood disintegrative disorder
299.11	Childhood disintegrative disorder, residual state
299.80	Asperger's disorder/pervasive developmental disorder
299.00	Autistic disorder, current or active state
296.00	Bipolar I disorder, single manic episode, unspecified
296.01	Bipolar I disorder, single manic episode, mild
296.02	Bipolar I disorder, single manic episode, moderate
296.03	Bipolar I disorder, single manic episode, severe without psychosis
296.04	Bipolar I disorder, single manic episode, severe with psychosis
206.05	Bipolar I disorder, single manic episode, in partial remission
296.06	Bipolar I disorder, single manic episode, in full remission
296.1	Manic recurrent episode
296.10	Manic disorder recurrent episode unspecified
296.11	Recurrent manic disorder, mild
296.12	Recurrent manic disorder, moderate
296.13	Recurrent manic disorder, severe
296.14	Manic affective disorder, recurrent episode, severe, specified as with psychotic behavior
296.15	Manic affective disorder, recurrent episode, in partial or unspecified remission
296.16	Recurrent manic disorder, full remission
296.40	Bipolar I disorder, most recent episode manic, unspecified
296.41	Bipolar I disorder, most recent episode manic, mild
296.42	Bipolar I disorder, most recent episode manic, moderate
296.43	Bipolar I disorder, most recent episode manic, severe without psychosis
296.44	Bipolar I disorder, most recent episode manic, severe with psychosis
296.45	Bipolar I disorder, most recent episode manic, in partial remission
296.46	Bipolar I disorder, most recent episode manic, in full remission
296.50	Bipolar I disorder, most recent episode depressed, unspecified
296.51	Bipolar I disorder, most recent episode depressed, mild
296.52	Bipolar I disorder, most recent episode depressed, moderate

ICD-9Code	Substance use disorder
296.53	Bipolar I disorder, most recent episode depressed, severe without psychosis
296.54	Bipolar I disorder, most recent episode depressed, severe with psychosis
296.55	Bipolar I disorder, most recent episode depressed in partial remission
296.56	Bipolar I disorder, most recent episode depressed, in full remission
296.60	Bipolar I disorder, most recent episode mixed, unspecified
296.61	Bipolar I disorder, most recent episode mixed, mild
296.62	Bipolar I disorder, most recent episode mixed, moderate
296.63	Bipolar I disorder, most recent episode mixed, severe without psychosis
296.64	Bipolar I disorder, most recent episode mixed, severe in partial remission
296.65	Bipolar I disorder, most recent episode mixed, in partial remission
296.66	Bipolar I disorder, most recent episode mixed, in full remission
296.7	Bipolar I disorder, most recent episode unspecified
296.80	Bipolar disorder NOS
296.81	Atypical manic disorder
296.89	Bipolar II disorder
301.11	Chronic hypomanic disorder
301.13	Cyclothymic disorder
296.2	Major depression, single episode, unspecified
296.20	Major depression, single episode, unspecified
296.21	Major depression, single episode, mild
296.22	Major depression, single episode, moderate
296.23	Major depression, single episode, severe without psychosis
296.24	Major depression, single episode, severe with psychosis
296.25	Major depression, single episode, in partial remission
296.26	Major depression, single episode, in partial remission
296.3	Major depression, recurrent, unspecified
296.30	Major depression, recurrent, unspecified
296.31	Major depression, recurrent, mild
296.32	Major depression, recurrent, moderate
296.33	Major depression, recurrent, severe without psychosis
296.34	Major depression, recurrent, severe with psychosis
296.35	Major depression, recurrent, in partial remission
296.36	Major depression, recurrent, in full remission
296.82	Atypical depressive disorder
298.0	Depressive-type psychosis
300.4	Dysthymia
301.12	Chronic depressive personality disorder
311	Depressive disorder NOS
309.0	Adjustment disorder with depressed mood
309.1	Prolonged depressive reaction
309.28	Adjustment disorder with mixed anxiety and depressed mood
297.1	Delusional disorder

ICD-9Code	Substance use disorder
297.3	Shared psychotic disorder
298.8	Brief psychotic disorder
298.9	Psychotic disorder NOS
310.0	Paranoid personality disorder
301.1	Affective personality disorder, unspecified
301.11	Chronic hypomanic personality disorder
301.12	Chronic depressive personality disorder
301.13	Cyclothymic disorder
301.2	Schizoid personality disorder
301.20	Schizoid personality disorder
301.3	Explosive
301.4	Obsessive compulsive personality disorder
301.5	Histrionic personality disorder
301.50	Histrionic personality disorder, unspecified
301.51	Chronic factitious illness with physical symptoms
301.52	Other histrionic personality disorder
301.6	Dependent personality disorder
301.7	Antisocial personality disorder
301.8	Other personality disorder
301.81	Narcissistic personality disorder
301.82	Avoidant personality disorder
301.83	Borderline personality disorder
301.84	Passive-aggressive personality
301.89	Other personality disorders
301.9	Unspecified personality disorder
295.0	Simple-type schizophrenia
295.00	Simple-type schizophrenia, unspecified
295.01	Simple-type schizophrenia, subchronic
295.02	Simple-type schizophrenia, chronic
295.03	Simple-type schizophrenia, subchronic with acute exacerbation
295.04	Simple-type schizophrenia, chronic with acute exacerbation
295.05	Simple-type schizophrenia, in remission
295.1	Disorganized-type schizophrenia, unspecified
295.11	Disorganized-type schizophrenia, subchronic
295.12	Disorganized-type schizophrenia, chronic
295.13	Disorganized-type schizophrenia, subchronic with acute exacerbation
295.14	Disorganized-type schizophrenia, chronic with acute exacerbation
295.15	Disorganized-type schizophrenia, in remission
295.2*	Catatonic-type schizophrenia
295.20	Catatonic type schizophrenia, unspecified
295.21	Catatonic type schizophrenia, subchronic
295.22	Catatonic type schizophrenia, chronic

ICD-9Code	Substance use disorder
295.23	Catatonic-type schizophrenia, subchronic with acute exacerbation
295.24	Catatonic-type schizophrenia, chronic with acute exacerbation
295.25	Catatonic-type schizophrenia, in remission
295.3	Schizophrenia, paranoid type
295.30	Paranoid-type schizophrenia, unspecified
295.32	Paranoid-type schizophrenia, subchronic
295.33	Paranoid-type schizophrenia, chronic
295.34	Paranoid-type schizophrenia, subchronic with acute exacerbation
295.35	Paranoid-type schizophrenia, in remission
295.4	Schizophreniform disorder
295.40	Schizophreniform disorder, unspecified
295.41	Schizophreniform disorder, subchronic
295.42	Schizophreniform disorder, chronic
295.43	Schizophreniform disorder, subchronic with acute exacerbation
295.44	Schizophreniform disorder, chronic with acute exacerbation
295.45	Schizophreniform disorder, in remission
295.5	Latent schizophrenia
295.50	Latent schizophrenia, unspecified
295.51	Latent schizophrenia, subchronic
295.52	Latent schizophrenia, chronic
295.53	Latent schizophrenia, subchronic with acute exacerbation
295.54	Latent schizophrenia, in remission
295.55	Latent schizophrenia, in remission
295.6*	Schizophrenia, residual type
295.60	Schizophrenic disorders, residual type, unspecified
295.61	Schizophrenic disorders, residual type, subchronic
295.62	Schizophrenic disorders, residual type, chronic
295.63	Schizophrenic disorders, residual type, subchronic with acute exacerbation
295.64	Schizophrenic disorders, residual type, chronic with acute exacerbation
295.65	Schizophrenic disorders, residual type, in remission
295.7	Schizoaffective disorder
295.70	Schizoaffective disorder, unspecified
295.71	Schizoaffective disorder, subchronic
295.72	Schizoaffective disorder, chronic
295.73	Schizoaffective disorder, subchronic with acute exacerbation
295.74	Schizoaffective disorder, chronic with acute exacerbation
295.75	Schizoaffective disorder, in remission
295.8	Other specified types of schizophrenia
295.80	Other specified types of schizophrenia, unspecified
295.81	Other specified types of schizophrenia, subchronic
295.82	Other specified types of schizophrenia, chronic
295.83	Other specified types of schizophrenia, subchronic with acute exacerbation

ICD-9Code	Substance use disorder
295.84	Other specified types of schizophrenia, chronic with acute exacerbation
295.85	Other unspecified types of schizophrenia, in remission
295.9	Unspecified schizophrenia
295.90	Unspecified schizophrenia, unspecified
295.91	Unspecified schizophrenia, subchronic
295.92	Unspecified schizophrenia, chronic
295.93	Unspecified schizophrenia, subchronic with acute exacerbation
295.94	Unspecified schizophrenia, chronic with acute exacerbation
295.95	Unspecified schizophrenia in remission

Highlights

- SMI is associated with disproportionately high odds of having several medical comorbidities.
- Having a SMI is associated with higher likelihood of chronic and severe medical conditions.
- Outreach strategies may be needed to reduce high medical need and poor outcomes in SMI.

Table 1

Patient characteristics.

	Bipolar *n* = 20,308		Control *n* = 20,308			Schizophrenia *n* = 4,782		Control *n* = 4,782		
Variable	***N***	***%***	***N***	***%***	***p*[a]**	***N***	***%***	***N***	***%***	***p*[a]**
Race/Ethnicity										
White	14331	70.5	10444	51.4	<.001	2580	53.9	2371	49.5	.017
Hispanic	2433	11.9	3400	16.9	<.001	626	13.0	780	16.3	<.001
Asian	1248	6.1	3403	16.7	<.001	615	12.8	828	17.3	<.001
Black	1459	7.1	1592	7.8	<.001	768	16.0	474	9.9	<.001
Unknown	837	4.1	1429	7.0	<.001	193	4.0	329	6.8	<.001
Male	7373	36.3	7374	36.3	*ns*	2356	49.2	2356	49.2	*ns*
Age *M, SD*	45.2	16.0	45.3	16.0	*ns*	47.3	16.2	47.3	16.2	*ns*
Income *M, SD*	60K	25019	61K	24653	<.001	57K	24971	61K	24304	<.001

Note. Control patients were matched one-to-one on gender, age, and medical home facility to patients with bipolar or schizophrenia, respectively. *ns* = non-significant *p*-values were equal to 1 for gender and age as patients were matched based on these variables. Income = neighborhood income.

[a]McNemar's χ^2 test or paired sample *t*-test (two-tailed).

Table 2

Conditional logistic regression models examining associations among patients with serious mental illness and medical conditions compared to controls.

	Bipolar				Schizophrenia			
	n = 20,308				*n* = 4,782			
Disease/Condition Category	***OR*[a]**	***95% CI***	***SE***	***p*[b]**	***OR*[a]**	***95% CI***	***SE***	***p*[b]**
Blood/Blood Forming Organs	2.21	2.02, 2.41	0.04	<.001	2.71	2.29, 3.21	0.08	<.001
Circulatory System	1.70	1.61, 1.79	0.02	<.001	1.86	1.68, 2.06	0.05	<.001
Digestive System	2.22	2.11, 2.34	0.02	<.001	2.19	1.99, 2.42	0.05	<.001
Endocrine/Immunity	2.34	2.22, 2.46	0.02	<.001	2.97	2.69, 3.28	0.05	<.001
Genitourinary	1.84	1.75, 1.93	0.02	<.001	1.59	1.44, 1.76	0.05	<.001
Infectious/Parasitic	1.78	1.68, 1.89	0.03	<.001	1.59	1.41, 1.79	0.06	<.001
Musculoskeletal	1.90	1.81, 1.98	0.02	<.001	1.07	0.98, 1.17	0.04	.127
Nervous System	1.94	1.85, 2.03	0.02	<.001	1.59	1.46, 1.74	0.04	<.001
Respiratory System	1.68	1.61, 1.76	0.02	<.001	1.50	1.34, 1.61	0.04	<.001

Note. All conditional logistic regression models adjusted for race/ethnicity and neighborhood income.

[a]Reference group = Control patients. Patients with bipolar and schizophrenia were matched to control patients, one-to-one on gender, age, and medical home facility.

[b]P-values were adjusted for multiple inference testing using the Hochberg[25] method.

Table 3

Conditional logistic regression models examining associations among patients with serious mental illness and severe or chronic medical conditions compared to controls.

Chronic Condition Category	Bipolar *n* = 20,308				Schizophrenia *n* = 4,782			
	OR[a]	*95% CI*	*SE*	*p*[b]	*OR*[a]	*95% CI*	*SE*	*p*[b]
Any Chronic Condition	2.11	2.01, 2.21	0.02	<.001	1.77	1.61, 1.94	0.04	<.001
Acid-Peptic Disorders	2.29	2.14, 2.45	0.03	<.001	2.44	2.14, 2.78	0.06	<.001
Arthritis	1.78	1.68, 1.88	0.02	<.001	1.15	1.03, 1.29	0.05	<.001
Asthma	2.05	1.92, 2.01	0.03	<.001	1.79	1.57, 2.05	0.06	<.001
Chronic Kidney Disease	2.41	2.14, 2.73	0.06	<.001	1.97	1.60, 2.43	0.10	<.001
Chronic Pain	4.77	4.33, 5.24	0.04	<.001	4.10	3.32, 5.05	0.10	<.001
COPD	2.49	2.25, 2.76	0.05	<.001	3.15	2.60, 3.83	0.09	<.001
Coronary Atherosclerosis	1.55	1.37, 1.76	0.06	<.001	1.73	1.36, 2.22	0.12	<.001
Diabetes Mellitus	1.69	1.57, 1.83	0.03	<.001	2.60	2.26, 2.99	0.07	<.001
Hepatitis C	4.08	3.23, 5.15	0.11	<.001	4.65	2.91, 7.44	0.23	<.001
Hypertension	1.65	1.56, 1.75	0.02	<.001	1.80	1.62, 2.01	0.05	<.001
Injury, poisoning/overdose	2.06	1.96, 2.16	0.02	<.001	1.59	1.44, 1.75	0.04	<.001
Ischemic heart disease	1.54	1.36, 1.75	0.06	<.001	1.75	1.37, 2.25	0.12	<.001
Pneumonia	2.10	1.80, 2.46	0.07	<.001	2.10	1.57, 2.79	0.14	<.001
Obesity	2.06	1.93, 2.20	0.03	<.001	2.84	2.46, 3.19	0.06	<.001
Stroke	2.58	2.02, 3.29	0.12	<.001	2.96	1.82, 4.82	0.24	<.001

Note. All conditional logistic regression models adjusted for race/ethnicity and neighborhood income. COPD = chronic obstructive pulmonary disease.

[a]Reference group = Control patients. Patients with bipolar and schizophrenia were matched to control patients, one-to-one on gender, age, and medical home facility.

[b]P-values were adjusted for multiple inference testing using the Hochberg[25] method.