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## The role of marijuana use disorder in predicting emergency department and inpatient encounters: A retrospective cohort study\*

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### Abstract

**Background**—Marijuana use disorder (MUD) is the most common illegal drug use disorder and its prevalence is increasing. It is associated with psychiatric and medical problems, but little is known about its impact on emergency department (ED) and inpatient utilization rates.

**Design**—In a retrospective cohort design, we used electronic health record (EHR) data to identify patients with MUD ( $n = 2,752$ ) and demographically matched patients without MUD ( $n = 2,752$ ) in 2010. Logistic regressions determined risk of ED and inpatient visits each year from 2010–2014 for MUD patients versus controls; mixed-effect growth models examined differences in utilization rates over 5-years. Patient characteristics predicting increased risk of utilization were examined among the MUD sample only.

**Key Results**—Rates of ED (OR = 0.87,  $p < .001$ ) and inpatient (OR = 0.76,  $p < .001$ ) services use significantly declined over 5 years for all patients. Patients with MUD exhibited a significantly greater decline in ED (OR = 0.81,  $p < .001$ ) and inpatient (OR = 0.64,  $p < .001$ ) use relative to controls. However, MUD patients had significantly greater risk of having ED and inpatient visits at each time point ( $p$ 's  $< .001$ ). MUD patients with co-occurring other substance use, medical, and/or psychiatric disorders had a greater risk of having ED or inpatient encounters over 5 years ( $p$ 's  $< .001$ ).

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#### Contributors

All authors assisted in the conceptualization and design of the study. Drs. Campbell and Bahorik conducted the literature searches and summaries of previous related work. Dr. Bahorik undertook the statistical analysis. Drs. Campbell and Bahorik wrote the first draft of the manuscript, which was revised and edited by all authors. All authors contributed to and have approved the final manuscript.

#### Conflicts of Interest

Dr. Campbell has been a co-investigator on a subcontract to her institution from Purdue Pharma. No other authors reported a conflict of interest.

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**Conclusions**—MUD patients remain at high risk for ED and inpatient visits despite decreasing utilization rates over 5 years. Addressing MUD patients' comorbid conditions in outpatient settings may help reduce inappropriate service use.

### Keywords

marijuana use disorder; cannabis; emergency department; inpatient; service utilization

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## 1. Introduction

Marijuana is the most commonly used “illicit” drug in the U.S. with approximately 12 million people over age 12 reporting past month use (Substance Abuse and Mental Health Services Administration), and marijuana use disorder (MUD) nearly doubling from 2001–2002 to 2012–2013 (Hasin et al., 2015). The addictiveness of marijuana continues to be debated as the landscape regarding marijuana legalization changes (Volkow et al., 2014), but the evidence largely indicates that excessive use can lead to adverse consequences and diagnoses of MUD (Degenhardt and Hall, 2012; Hall and Degenhardt, 2009; Volkow et al., 2016). In 2014, 4.1 million people 12 years of age or older met the DSM-IV criteria for MUD nationally (Substance Abuse and Mental Health Services Administration). In addition, most people who develop MUD have comorbid conditions that can worsen prognosis and contribute to poor health outcomes (Degenhardt and Hall, 2012; Hall and Degenhardt, 2009; Substance Abuse and Mental Health Services Administration).

Regular and heavy marijuana use is associated with increased risk of anxiety, depression, and psychoses, although causality has not been established (Moore et al., 2007; Volkow et al., 2014). In addition, heavy use, high potency, and exposure at younger ages can all negatively affect the course of mental illness (Volkow et al., 2014). Marijuana use among adolescents also predicts increased risk of MUD in adulthood (Volkow et al., 2014), which, in turn predicts, high risk of other drug use and escalation to co-occurring substance use disorder (Hall and Degenhardt, 2007). Marijuana frequently is used by persons who drink in excess and use other illicit drugs (Hall and Degenhardt, 2009), which compounds risk to health and safety.

Marijuana is associated with increased risk of several medical conditions. Regular and heavy marijuana use can contribute to respiratory deficits such as airway resistance, large airway inflammation, lung hyperinflation, and can lead to chronic bronchitis (Tashkin, 2013; Tetrault et al., 2007). Marijuana use is also related to a high risk of respiratory infections and pneumonia (Owen et al., 2014), vascular conditions that raise the risk of cardio/cerebrovascular events, such as stroke and myocardial infarction (Thomas et al., 2014), and an increased risk of lung and digestive track cancers (Tashkin, 2013). Not surprisingly, these medical conditions are even more prominent among those with MUDs and contribute considerably to the burden of disease (Bahorik et al., 2017). Marijuana has also been associated with increased risk of motor vehicle accidents, and other acute health events (Monte et al., 2015; Rogeberg and Elvik, 2016).

Despite the adverse health effects of MUD, few studies have examined the relationship of MUD to emergency and inpatient service utilization. These are among the most costly health

services, and may indicate inappropriate use of health care and/or unmet need. The few studies in this area have focused on any marijuana use rather than on higher severity users with MUD; although MUD patients are likely at the highest risk for utilizing ED and inpatient resources, given the disorder's consistent association with adverse outcomes and poor health. One recent study found marijuana, either used alone or in combination with other drugs, is often reported by those who have ED visits, and this number has increased over the past decade (Volkow et al., 2014; Zhu and Wu, 2016). Results are mixed regarding the effect of substance use on inpatient use (Burke et al., 2013; Palepu et al., 2005; Walley et al., 2012); and one study found no evidence of an association between frequency of marijuana use and hospital admissions (Fuster et al., 2014). The degree to which such findings are specific to marijuana use or persist over time in persons with MUD, who likely have more complex clinical presentation and service needs than those with subdiagnostic use, is largely unknown.

This study addresses this important question by examining emergency and hospitalization utilization trends and trajectories in a large sample of 2,752 patients with MUD and 2,752 healthy controls in a large integrated health care system. Using electronic health record (EHR) data, we aimed to: (1) Determine the risk of ED and inpatient visits each year from 2010 to 2014 for MUD patients relative to controls; (2) Examine differences in the rates of emergency department and inpatient utilization between MUD patients and controls over 5-years; and (3) Identify predictors of emergency department and inpatient utilization over time within the MUD sample.

## 2. Methods

### 2.1 Setting

Kaiser Permanente Northern California (KPNC) is a nonprofit, integrated health care delivery system with 3.8 million members, who account for 45% of the commercially insured population in the region. KPNC operates 21 medical centers and employs more than 7,000 physicians. About 78% of members are commercially insured, 14% have Medicare and 8% have Medicaid or other charitable coverage. All participants were selected from the KPNC membership.

### 2.2. Study participants

This secondary analysis study used EHR data to identify all health system members who: 1) were aged 18 or older, 2) had a visit to a KPNC facility in 2010, and 3) had a recorded ICD-9 diagnosis of marijuana abuse or dependence (i.e., MUD; 305.2–22; 304.3–303.32) in 2010. Any current or existing behavioral health diagnosis (e.g., alcohol use disorder, depression, etc.) additionally documented for the MUD patients during health care visits from January 1, 2010 to December 31, 2010 were also included (Appendix 1<sup>1</sup>). Within KPNC, MUD and other behavioral health diagnoses can be assigned to patients in any clinic setting (e.g., primary care or specialty care clinic). Diagnoses can be assigned by physicians

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<sup>1</sup>Supplementary material can be found by accessing the online version of this paper at <http://dx.doi.org> and by entering doi: ...

or any other qualified health care provider who is directly evaluating a patient. All diagnoses are captured through ICD-9 codes.

Control patients were then selected for all unique MUD patients – matching one-to-one on gender, age, and medical home facility, but having no MUD, or any other current behavioral health diagnosis. This accounted for any differences in services, types of behavioral health conditions, or unobservable differences by geographic location. Patients with Medicaid/Medicare were excluded. To control for varying lengths of membership, participants were required to be KPNC members for at least 80% of the study period (at least 4 out of the 5 years examined) as done in prior work (Ray et al., 2005).

The analytical sample consisted of 5,504 individuals: 2,752 patients with a MUD and 2,752 patients without a MUD. Institutional review board approval for the study was obtained from the Kaiser Foundation Research Institute.

### 2.3. Key measures

**2.3.1 Patient characteristics**—Age, gender, race/ethnicity, neighborhood income, and diagnoses were extracted from the EHR. Race/ethnicity was collapsed into five categories: White, Black, Hispanic, Asian, and other. Neighborhood income was measured using 2010 census data, based on member zip code. Comorbid medical conditions were measured by the Charlson Comorbidity Index (Charlson et al., 2008); higher scores indicate greater medical disease burden. Patients in the overall sample were determined to have a tobacco use disorder (ICD-9: 305.1) if documented during a patient visit in 2010. Patients with MUD were determined to have other co-occurring or substance use and/or psychiatric disorders (Appendix 1<sup>2</sup>), based any current or existing ICD-9 diagnoses documented during patient visits in 2010.

**2.3.2 Service Utilization**—KPNC health service utilization data between 2010 and 2014 were extracted from the EHR. For each year, we defined separate dichotomous measures of ED and inpatient hospitalization, (1 = present, 0 = else). Services use external to KPNC was captured through claims data. External ED use that KPNC paid for is captured through claims data.

### 2.4 Analyses

Frequencies and means were used to characterize the sample. We then employed  $\chi^2$  tests (categorical variables) and independent *t* tests (continuous variables) to identify differences between MUD patients and controls. To compare the odds of ED and inpatient visits, we first conducted cross-sectional analyses with a series of multivariate logistic regression analyses for each year (2010, 2011, 2013, and 2014) comparing MUD patients to controls. All models adjusted for gender (1 = men; 0 = else), race/ethnicity (white = reference; Hispanic, Asian, black, unknown), age (18–29 = reference; 30–39; 40–49; 50+), neighborhood income (1 = median annual income per household < 50K, 0 = else), medical

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comorbidity (Charlson Comorbidity Index score) and tobacco use disorder (1 = tobacco use disorder; 0 = else).

Longitudinal analyses were conducted within a generalized mixed-effects growth model framework, using penalized-quasi likelihood estimation for computing parameter estimates of binary outcomes. This approach to longitudinal data analysis is a form of hierarchical linear modeling for repeated measures data, where multiple measurement occasions are nested within persons (Raudenbush and Bryk, 2009). These analyses began with unconditional growth models predicting ED or inpatient use over time (coded: 0 = 2010; 1 = 2011; 2 = 2012; 3 = 2013; 4 = 2014) to examine the service use trajectory of patients in the overall sample (combined samples of MUD patients and controls). We then constructed conditional growth models predicting ED or inpatient use over time including a time x MUD (reference group = control) interaction, to examine differences among MUD patients and the controls in their use of ED and inpatient services over 5 years. For this conditional growth model, the time x MUD interaction effect indicates the differences in the rates of ED and inpatient utilization between MUD patients and controls over 5 years, controlling for individual socio-demographic characteristics (e.g., age, gender, race/ethnicity, income, medical comorbidity, and tobacco use disorder).

In the final analyses, we examined only MUD patients to identify those at risk for higher utilization of ED and inpatient services. Conditional growth models including interactions with time were computed for the following predictors of interest: age, gender, race/ethnicity, income, SUD comorbidity (1 = any SUD; 0 = else), psychiatric diagnosis (1 = any psychiatric diagnosis; 0 = else), medical comorbidity, and tobacco use disorder. Analyses were performed in R version 2.14.2 (Raudenbush and Bryk, 2009) and HLM 7 (Raudenbush et al., 2013). Statistical significance was defined at  $p < .05$ .

### 3. Results

#### 3.1. Overall sample characteristics and differences between patients with marijuana use disorders and controls

Overall, the sample was 35.5% women, 59.8% white, 16.1% Hispanic, 11.0% Asian, 8.6% black, and 4.0% other race/ethnicity. Participants were 37 years old on average (SD = 15.5) and 50.0% had a median household income  $\leq$  \$50K. As shown in Table 1, fewer MUD patients lived in neighborhoods with a median household income  $\leq$  \$50K compared to control patients. More MUD patients were white or black compared to control patients; more controls were Asian, Hispanic, or had a race/ethnicity categorized as other than those with MUD. Patients with MUD had greater prevalence of tobacco use disorder and medical comorbidities than controls. Among MUD patients, co-occurring other substance use and mental health conditions were common (Table 2).

#### 3.2. Emergency Department and inpatient hospital utilization trends and trajectories among patients with marijuana use disorders and controls

ED and inpatient hospital utilization trends for MUD patients and controls were examined during each year (2010 to 2014). As shown in Figure 1, MUD patients had higher odds of

having an ED admission at each time point relative to controls ( $p$ 's < .001); the odds decreased from 2010 to 2014. Similarly, MUD patients had higher odds of having inpatient hospitalization encounters at each time point relative to controls ( $p$ 's < .001), and these odds decreased from 2010 to 2014 (Figure 1).

As shown in Table 3, results of the longitudinal unconditional growth models revealed utilization of ED (OR = 0.87 [95% CI = 0.855, 0.888],  $p$  < .001) and inpatient hospitalization (OR = 0.76 [95% CI = 0.738, 0.785],  $p$  < .001) services significantly declined in the overall sample. Results of the conditional growth models further showed MUD patients were more likely than controls to have ED (OR = 1.19 [95% CI = 2.989, 3.673],  $p$  < .001) and inpatient visits (OR = 6.78 [95% CI = 5.579, 8.263],  $p$  < .001) in 2010, and MUD patients exhibited a significantly faster decline in their utilization of ED (OR = 0.81 [95% CI = 0.781, 0.848],  $p$  < .001) and inpatient (OR = 0.64 [95% CI = 0.643, 0.694],  $p$  < .001) services relative to controls over the 5-year follow-up.

### 3.3 Longitudinal predictors of Emergency and inpatient hospital utilization among patients with marijuana use disorders

We then sought to identify predictors of increased risk of ED and inpatient service utilization in the MUD sample. As can be seen in Table 4, results of the mixed-effect growth models revealed that MUD patients with an "other" race/ethnicity compared to whites, and those with tobacco use disorder, co-occurring medical, substance use, or psychiatric conditions had higher odds of ED and inpatient service utilization (see Table 4).

## 4. Discussion

Marijuana increasingly takes center stage in public policy and debate as legislation to legalize marijuana spreads and use for medical purposes is already established in many states (Volkow et al., 2016). Attitudes towards liberalization are normalizing, particularly among youth (Campbell et al., 2016), with regular users at high risk of addiction and developing MUD in adulthood (Hall and Degenhardt, 2007; Volkow et al., 2014). Consequently, patterns of marijuana use and MUD are rapidly changing and have considerable implications for health systems. This study examined how adult patients with MUD use ED and inpatient resources over time, services that suggest poor health and/or inappropriate use of health care. Findings suggest MUD patients remained at higher risk for having ED and inpatient hospital visits than controls, even though their use of these services declined at a faster rate over the study follow-up period. Further, for MUD patients with co-occurring conditions, utilization of ED and inpatient services continued to increase throughout the follow-up, suggesting these patients may need identification and intervention to address health problems before they become acute.

Similar to other studies with different designs and populations (Substance Abuse and Mental Health Services Administration), we found that MUD patients had high levels of concurrent medical, psychiatric and substance use disorders. Because these conditions worsen prognosis, lead to high morbidity, and contribute to inappropriate service use (Hall and Degenhardt, 2009; Wu et al., 2012), it is not surprising we found that MUD patients had consistently greater likelihood of hospital and ED use relative to controls. In contrast, one

recent study reported no association between any marijuana use and patients' hospital or ED admission status, but this sample consisted of adults who did not have significant medical comorbidity and the study identified frequent use, but not MUD (Fuster et al., 2014). This difference may reflect the higher severity of patients in our sample, who likely have greater impact on health system resources. Although not specific to MUD, the broader evidence-base suggests high ED and hospital utilization among those with substance use disorders is associated with poor health, accidents, and concurrent use of multiple substances (Frank et al., 2015; Substance Abuse and Mental Health Services Administration; Wu et al., 2012), signaling unmet service needs in specialty care, such as addiction treatment and psychiatric care. Further, as legalization evolves and the availability of marijuana increases, there is heightened concern that MUD prevalence and associated health problems will increase (Volkow et al., 2014). Consequently, building on initial work in this area, it will be critical for future studies (Blow et al., 2010; Macias Konstantopoulos et al., 2014) to explore the efficacy and feasibility of enhanced screening and intervention for marijuana use and MUD in ED and inpatient settings.

Over time all patients had fewer visits, but patients with MUDs experienced a more rapid decrease of visits compared to controls, though MUD patients still maintained higher use at each time point. National data have showed increasing ED visits involving marijuana use (Volkow et al., 2014). This national increase could be due to the combined effects of increasing marijuana potency, liberalizing views of the drug, and increasing trends toward its legalization (Volkow et al., 2014; Volkow et al., 2016). However, our finding of a decrease in ED or inpatient utilization over time may suggest that some patients' health may improve (though this may not be the case for comorbid patients), and/or may be specific to patients receiving services within integrated health systems where specialty services are provided internally. While we cannot measure this with the current data, it is possible that MUD patients may be more likely to be linked with addiction treatment and other specialty services, as well as primary care services, following an inpatient or ED encounter, potentially reducing the need for subsequent acute care. There are condition- and specialty-specific clinical decision support tools embedded in the EHR to assist hospitalists and ED care teams in linking patients back to both primary and secondary care. For example, during an ED encounter patients can be booked into a follow-up primary care appointment. Prior studies in KPNC have shown patients who have ongoing primary care and addiction treatment are less likely to have subsequent ED visits and inpatient admissions, and this may be related to improved substance use and health outcomes (Chi et al., 2011; Parthasarathy et al., 2012). Despite decreasing utilization rates, it is critical to note that MUD patients were at higher risk of using these services over the follow-up compared to controls, with twice the risk even at the last time point. Thus, MUD patients remain at high risk for ED and inpatient visits despite a more rapid decrease in utilization over time.

The health impacts of marijuana use remain controversial as policies evolve, yet our findings indicate that patients with MUD do have more severe health conditions. Co-occurring psychiatric and other substance use disorders and medical conditions were associated with higher odds of ED and inpatient utilization. Each of these comorbidities is overrepresented among patients who have frequent and inappropriate use of health care services (Calcaterra et al., 2013; Edlund et al., 2007; Schuckit, 2009). Most of the related research has focused



on patients with alcohol or opioid use disorder, and our findings extend the literature to those with MUD. Patients with MUD are likely to have frequent ED and inpatient visits requiring a range of medical treatments, psychiatric symptom stabilization or detoxification from other drugs or alcohol. This suggests that MUD patients' presenting problem may not be their only or most severe problem, and clinicians should routinely assess and address multiple co-occurring conditions in these individuals.

Several limitations should be noted. We relied on provider-assigned clinical diagnoses, which limited the sample to patients who had a MUD disorder diagnosis and a health care visit, which may represent the lower bound of identified MUD, though we did include current and preexisting diagnoses. We did not have data on rate or frequency of marijuana use; it is important to examine outcomes related to the extent and severity of marijuana-related problems in future prospective studies. We did not have data on the reason for ED or hospital admission or length of stay, which are important areas of further investigation. ED utilization that Kaiser did not pay for is not captured. Patients were insured members of an integrated health system, and the results may not be generalizable to uninsured populations or to other types of health plans. As noted previously, patients were required to have a health plan visit in 2010 for cohort selection, but were not required to have a health plan visit in subsequent years, which may partially explain the steep decline in ED and inpatient hospitalization visits between 2010 and 2011 and the subsequent leveling off of ED use from 2011 to 2014. However, patients were required to have membership four of the five years, and visits continued to decline over the study period; utilization for MUD patients were consistently higher than non-MUD patients.

This study found that MUD patients remained at high risk for having ED and inpatient visits, even though utilization of these services significantly declined over 5-years. Utilization of ED and inpatient services was higher for MUD patients with co-occurring conditions throughout the follow-up, suggesting that targeting these patients for outreach and intervention may be a useful strategy for improving outcomes.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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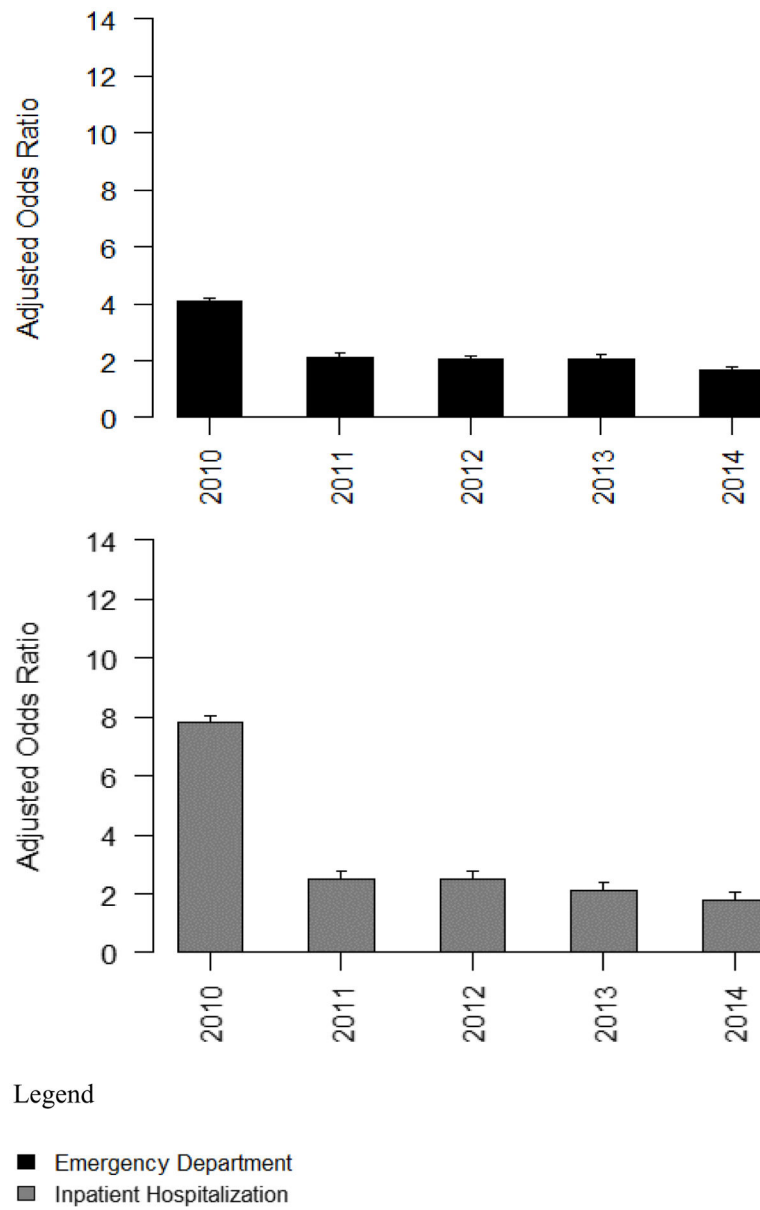
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**Highlights**

- Marijuana Use Disorder (MUD) patients are at higher risk of having emergency department (ED) and inpatient visits than controls.
- ED and inpatient services use declined over 5 years for all patients.
- MUD patients had a significantly greater decline relative to controls over 5 years.
- MUD patients with comorbidity are at greater risk of ED or inpatient encounters.



**Figure 1.** Adjusted odds ratios of emergency department and inpatient hospital among marijuana use disorder patients (n=2,752) versus controls (n=2,752) for all years 2010 to 2014.

**Table 1**  
 Characteristics and service utilization for patients with marijuana use disorder versus controls

Variable	Marijuana <i>n</i> = 2,752		Control <i>n</i> = 2,752		<i>p</i> <sup>a</sup>
	<i>N</i>	%	<i>N</i>	%	
Race/Ethnicity					
White	1672	60.7	1270	46.1	<.001
Hispanic	433	15.7	519	18.8	<.001
Asian	129	4.6	557	20.2	<.001
Black	432	15.6	242	8.7	<.001
Unknown	86	3.1	164	5.9	<.001
Male	1766	64.1	1768	64.2	.977
Income 50K	1284	46.6	1391	50.5	<.001
Age <i>M, SD</i> (years)	36.48	15.17	36.80	15.23	.433
Tobacco Use Disorder	924	33.5	63	2.2	<.001
Medical Comorbidity <i>M, SD</i> (score <sup>b</sup> )	0.33	0.89	0.20	0.63	<.001
Utilization					
Emergency Department					
2010	1470	53.4	459	16.6	<.001
2011	917	33.3	444	16.1	<.001
2012	877	31.8	448	16.2	<.001
2013	856	31.1	394	14.3	<.001
2014	819	29.7	442	16.0	<.001
Inpatient Hospital					
2010	778	28.2	103	3.7	<.001
2011	322	11.7	92	3.3	<.001
2012	268	9.7	88	3.1	<.001
2013	248	9.0	94	3.4	<.001
2014	237	8.6	111	4.0	<.001

*Note.* Control = patients without any substance use disorder who were matched one-to-one on gender, age, and medical home facility to patients with marijuana use disorders. Income = median neighborhood income.

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Charlson Comorbidity Index = higher mean scores indicate greater medical disease burden.

**Table 2**

Substance use disorder and mental health condition comorbidity among patients with marijuana use disorder

Variable	<u>Marijuana Use Disorder</u> <i>n</i> = 2,752
Substance Use Disorder —%	
Alcohol	32.9
Opioid	9.8
Amphetamine	7.6
Cocaine	5.7
Barbiturate	2.8
Hallucinogen	0.9
Substance Use Disorder Comorbidity—%	
>1 SUD	55.8
>2 SUD	32.2
Mental Health Condition —%	
Depression	40.1
Anxiety	31.2
Bipolar	10.4
Other Psychoses	5.7
ADHD	5.5
Personality Disorder	5.1
Schizophrenia	3.2
Dementia	0.5
Autism	0.2
Mental Health Condition Comorbidity —%	
>1 MH	28.8
>2 MH	8.6

*Note.* SUD = substance use disorder. ADHD = attention deficit hyperactivity disorder. MH = mental health condition.



**Table 3**

Longitudinal impact of marijuana use disorder versus controls on emergency department and inpatient utilization from 2010 to 2014

Variable	Emergency Department			
	OR	95% CI	SE	p
Unconditional Growth Model				
Initial Status	0.45	0.436, 0.477	0.02	<.001
Time	0.87	0.855, 0.888	0.01	<.001
Conditional Growth Model				
Initial Status	0.24	0.220, 0.271	0.01	<.001
Race/Ethnicity <sup>a</sup>				
Hispanic	0.90	0.862, 0.945	0.01	<.001
Asian	1.07	1.047, 1.106	0.01	<.001
Black	0.84	0.816, 0.888	0.01	<.001
Other	1.25	1.206, 1.300	0.01	<.001
Age <sup>b</sup>				
30–39	0.99	0.960, 1.039	0.01	.940
40–49	0.95	0.922, 0.992	0.01	.017
50+	0.91	0.883, 0.943	0.01	<.001
Male	0.89	0.846, 0.953	0.02	.005
Income < 50K	0.88	0.838, 0.942	0.02	.003
Medical Comorbidity <sup>c</sup>	1.30	1.255, 1.347	0.01	<.001
Tobacco Use Disorder	1.82	1.693, 1.957	0.01	<.001
Marijuana <sup>d</sup>	1.19	2.989, 3.673	0.05	<.001
Time	0.97	0.946, 1.009	0.01	.139
Time x Marijuana <sup>d</sup>	0.81	0.781, 0.848	0.01	<.001
Inpatient Hospital				
Unconditional Growth Model				
Initial Status	0.15	0.142, 0.161	0.03	<.001
Time	0.76	0.738, 0.785	0.01	<.001
Conditional Growth Model				
Initial Status	0.04	0.036, 0.054	0.10	<.001
Race/Ethnicity <sup>a</sup>				
Hispanic	0.90	0.824, 0.994	0.04	.037
Asian	0.99	0.816, 1.051	0.02	.835
Black	0.87	0.816, 0.949	0.03	<.001
Other	1.22	1.129, 1.336	0.04	<.001
Age <sup>b</sup>				

Variable	Emergency Department			
	OR	95% CI	SE	p
30–39	0.94	0.873, 1.015	0.03	.116
40–49	1.12	1.044, 1.202	0.02	.002
50+	0.93	0.883, 1.000	0.02	.040
Male	0.50	0.454, 0.569	0.05	<.001
Income 50K	0.91	0.815, 1.022	0.05	.115
Medical Comorbidity <sup>c</sup>	1.38	1.348, 1.414	0.02	<.001
Tobacco Use Disorder	1.83	1.608, 2.088	0.06	<.001
Marijuana <sup>d</sup>	6.78	5.579, 8.263	0.10	<.001
Time	1.02	0.956, 1.089	0.03	.556
Time x Marijuana <sup>d</sup>	0.64	0.643, 0.694	0.03	<.001

Marijuana = patients with marijuana use disorders.

<sup>a</sup> reference = White

<sup>b</sup> reference = ages 18–29

<sup>c</sup> Charlson Comorbidity Index; higher scores indicate greater medical disease burden.

<sup>d</sup> reference = controls

**Table 4**

Longitudinal predictors of emergency department and inpatient utilization among marijuana use disorder patients from 2010 to 2014

Variable	Emergency Department			
	OR	95% CI	SE	p
Unconditional Growth Model				
Initial Status	0.85	0.806, 0.907	0.03	<.001
Time	0.80	0.784, 0.824	0.01	<.001
Conditional Growth Model				
Initial Status	0.86	0.818, 0.921	0.03	<.001
Time	0.70	0.670, 0.743	0.02	<.001
Race/Ethnicity <sup>a</sup>				
Hispanic	0.98	0.956, 1.010	0.01	.206
Asian	1.02	1.000, 1.041	0.01	<.001
Black	0.94	0.923, 0.962	0.01	<.001
Other	1.08	1.055, 1.106	0.01	<.001
Age <sup>b</sup>				
30–39	0.99	0.972, 1.016	0.01	.579
40–49	0.99	0.979, 1.019	0.01	.937
50+	0.95	0.942, 0.977	0.01	<.001
Male	0.95	0.920, 0.982	0.01	.003
Income < 50K	0.93	0.909, 0.970	0.01	<.001
Medical Comorbidity <sup>c</sup>				
SUD Comorbidity	1.09	1.073, 1.112	0.05	<.001
MH Comorbidity	1.10	1.071, 1.142	0.01	.164
Tobacco Use Disorder	1.12	1.107, 1.111	0.01	<.001
Inpatient Hospital				
Unconditional Growth Model				
Initial Status	0.15	0.142, 0.161	0.03	<.001
Time	0.76	0.738, 0.785	0.01	<.001
Conditional Growth Model				
Initial Status	0.30	0.287, 0.333	0.03	<.001
Time	0.56	0.518, 0.616	0.04	<.001
Race/Ethnicity <sup>a</sup>				
Hispanic	0.95	0.911, 1.010	0.02	.117
Asian	0.98	0.952, 1.016	0.01	.307
Black	0.95	0.920, 0.996	0.01	.031
Other	1.10	1.039, 1.165	0.03	.001
Age <sup>b</sup>				

Variable	Emergency Department			
	OR	95% CI	SE	p
30–39	1.01	0.967, 1.054	0.02	.465
40–49	1.01	0.978, 1.049	0.01	.480
50+	0.93	0.908, 0.965	0.01	<.001
Male	0.86	0.824, 0.917	0.02	<.001
Income 50K	0.96	0.916, 1.020	0.02	.212
Medical Comorbidity <sup>c</sup>	1.12	1.102, 1.147	0.01	<.001
SUD Comorbidity	1.07	1.018, 1.132	0.02	.009
MH Comorbidity	1.22	1.155, 1.299	0.02	<.001
Tobacco Use Disorder	1.19	1.33, 1.258	0.02	<.001

<sup>a</sup> reference = White

<sup>b</sup> reference = ages 18–29

<sup>c</sup> Charlson Comorbidity Index; higher scores indicate greater medical disease burden.