

Associations between Psychiatric Disorders and Cannabis-Related Disorders Documented in Electronic Health Records

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ABSTRACT

Data from a large network of community health centers connected via a single electronic health record (EHR) system examined associations between psychiatric disorders and documentation of a cannabis-related disorder among patients with reported cannabis use. Participants were adults who had at least one ambulatory visit at a clinic in three states between 1/1/2012 and 12/31/2016 and had either 1) a documented cannabis-related disorder indicated by an ICD-9/10 code on the problem list or encounter list or 2) documentation of cannabis use in the EHR social history section. Clinics included 101,405 patients with either cannabis use recorded in the social history of the EHR ($n = 71,660$) or a cannabis-related disorder documented in the encounter or problem list ($n = 29,745$). GEE logistic regression modeling estimated adjusted odds ratios (aOR). Odds of patients having cannabis-related disorder recorded on the encounter or problem list were higher for individuals with depression (aOR = 1.08, 95% CI: 1.04–1.13), anxiety (aOR = 1.16, CI: 1.11–1.21) and bipolar disorder (aOR = 1.16, CI: 1.10–1.23). A diagnosis of schizophrenia increased the odds of a cannabis-related disorder by 62% (aOR = 1.62, CI: 1.48–1.78). Primary care providers should routinely screen for and document cannabis-related disorders and psychiatric disorders.

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Introduction

The 2018 National Survey on Drug Use and Health estimated that 27.7 million Americans (10.1% of the population aged 12 or older) used cannabis in the past 30 days and 22.1% of those between ages of 18 and 25 used cannabis in the past month (Substance Abuse and Mental Health Services Administration 2019). More than half of U.S. states have legalized medical cannabis use and state-level initiatives have legalized and/or decriminalized nonmedical cannabis use in 10 states and the District of Columbia. In the wake of cannabis legalization, the proportion of regular cannabis users is expected to increase (Hall and Weier 2015; Maxwell and Mendelson 2016). Increased cannabis use is a concern because frequent use can lead to cannabis use disorders (CUD), with 25–50% of daily users developing CUD (Volkow et al. 2014). However, cannabis has been used to treat individuals with chronic pain, neuropathic pain, and spasticity due to multiple sclerosis (Hill 2015; Whiting et al. 2015), and the FDA has approved a medication using cannabidiol extracted from cannabis for the treatment of two pediatric

seizure disorders (drugabuse.gov, 2018). In interviews with primary care patients who use cannabis, they reported smoking, inhaling, ingesting, and applying a wide variety of cannabis products (Hoffman et al. 2017). It is, therefore, crucial for health-care providers to better understand the degree to which patients are using cannabis products as well as the psychiatric and physical health implications of use.

Cannabis and Psychiatric Health

Epidemiological research suggests associations between cannabis use and increased risk of psychotic outcomes, including the development of schizophrenia. This risk follows a dose-response relationship (Marconi et al. 2016) and is greater among those who start using at a young age and use high-potency cannabis (Di Forti et al. 2014; Forti et al. 2015). Other studies have found associations between cannabis use and increased risk of depression, anxiety, suicidality, and substance use disorders (Brook et al. 2002; Hayatbakhsh et al. 2007; Patton et al. 2002; van Laar et al. 2007; Gobbi et al.

2019). On the other hand, 47% of adults in the US believe cannabis can provide relief from anxiety, stress, and depression (Keyhani et al. 2018).

The link between cannabis use and psychiatric disorders has stimulated public interest (Di Forti et al. 2019; Fergusson, Horwood, and Swain-Campbell 2003; Hasin et al. 2016; Stinson et al. 2006; van Os et al. 2002). Daily cannabis users and those who use high-potency cannabis were more likely to have a psychotic disorder than those who never used cannabis or used low-potency cannabis (Di Forti et al. 2019). The introduction and popularity of cannabis products with elevated concentrations of tetrahydrocannabinol (THC) adds to the debate about links between cannabis use and psychiatric health conditions. The U.S. Drug Enforcement Agency (DEA) reports a marked increase in the average potency of cannabis from 4% in 1995 to approximately 12% in 2014 (ElSohly et al. 2016). Cannabis resin, moreover, may contain 20% THC and cannabis oil may have 75% THC (Raber, Elzinga, and Kaplan 2015). European statistics show that in 2011, cannabis varied in THC content across countries, ranging from an average of 4% in Hungary to 16% in the Netherlands (European Monitoring Centre for Drugs and Drug Addiction 2011). More recently, there has been an increase in potency, largely due to the availability of genetic strains with high levels of THC (European Monitoring Centre for Drugs and Drug Addiction 2015).

With the growth in regular users and the elevated levels of THC, combined with states and countries that permit medical and non-medical cannabis use, it is increasingly recommended that primary care providers screen for and document use in electronic health records (EHRs) to monitor health outcomes. Systematically assessing and documenting cannabis use in patients' electronic health records would allow for a comprehensive assessment of the benefits and harms associated with use (Hoffman et al. 2017). In the U.S. and in much of Europe, however, EHRs are not standardized and rarely include routine assessments of cannabis use, products used, and duration of use. The current study used data from a large network of community health centers connected via a single EHR system to 1) examine associations between psychiatric disorders and documentation of a cannabis-related disorder among patients with reported cannabis use and, 2) to assess the clinical value of cannabis reports found in the EHR social history and diagnoses recorded in the encounter list and the problem list.

Methods

Patient demographics, cannabis use, and psychiatric health diagnoses were extracted from EHR data from

the OCHIN (not an acronym) network of community health centers and safety net clinics. Safety net clinics are defined as health-care organizations that provide care to individuals regardless of ability to pay (Institute of Medicine 2000). Study participants were male and female patients 18 years of age and older who had at least one ambulatory visit at an OCHIN clinic in Oregon, California, or Washington state between January 1, 2012 and December 31, 2016 and who had (1) a documented cannabis-related disorder as indicated by an ICD-9/10 code on the problem list or encounter list, or (2) a record of cannabis use in the social history section of the EHR. We included the three U.S. western states as the majority of OCHIN clinics are located in these states and they were among the first to legalize medical cannabis. Patients at clinics with less than five total patients in the sample were removed. The dependent variable was a binary indicator of a cannabis-related disorder (vs. cannabis use recorded in the social history without a diagnosis of a cannabis-related disorder). The independent variables were separate indicators for five psychiatric disorders: depression, anxiety, bipolar disorder, schizophrenia, and post-traumatic stress disorder (PTSD). These were measured as binary variables (yes or no) if the respective ICD 9 or 10 codes appeared in a patient's problem or encounter list during the study period.

The models evaluating the association between cannabis-related disorders and psychiatric health included covariates that either are (Substance Abuse and Mental Health Services Administration 2019) or might be associated with cannabis use and cannabis use disorders to control for possible confounding influences age when cannabis use was recorded in the health record, gender (female or male), race/ethnicity (Hispanic, non-Hispanic White, non-Hispanic Black, non-Hispanic of other race, or unknown), patient's primary insurance (private, public, or uninsured), federal poverty level (above or below 138% or unknown), clinic state (California, Oregon, Washington), whether a patient's medical record indicated a comorbid substance use diagnoses (i.e., opioid, alcohol, or other substance including sedatives, cocaine, hallucinogens, inhalants, other stimulants, or multiple substances), cigarette smoking status (yes or no), and the number of visits a patient had in the study period (summarized by quartile categories). Using generalized estimating equation (GEE) logistic regression modeling, we estimated adjusted odds ratios of a documented cannabis-related disorder among cannabis users comparing patients with documented psychiatric disorders versus those without psychiatric disorders.

Five univariable models were run to explore the crude associations between cannabis use disorder and each psychiatric condition. Adjusted odds ratios (aOR) were obtained from a multivariable GEE logistic model including all psychiatric disorders and the full set of covariates. A priori hypothesized differences in documentation of cannabis-related disorders and prevalence of two psychiatric disorders (anxiety disorders and depressive disorders) between genders were explored by extending the overall multivariable GEE logistic model with the inclusion of an interaction term. First, we considered a multivariable model with inclusion of an interaction between patient's sex and depression. A separate GEE logistic model examined the interaction between sex and anxiety. All models accounted for clustering by clinic through the implementation of robust standard errors. Statistical models were performed using STATA version MP15, with statistical significance taken at a p -value less than 0.05. This study was approved by the Oregon Health & Science University Institutional Review Board.

Results

Patient characteristics

Table 1 summarizes the study sample. Study clinics included 101,405 patients with documentation of either cannabis use or a cannabis-related disorder. Approximately one-third of the study patients had a diagnosis related to depression (39%) and/or anxiety (34%). Additionally, a number of patients had bipolar disorder (10%), schizophrenia (5%), and/or PTSD (8%). Men were more likely than women (56% vs 44%) to have cannabis use recorded in their social history but men and women were equally likely to have an indication of a cannabis-related disorder (50% vs. 51%). The sample was predominantly White (69%) and Hispanic (12%) with smaller numbers of non-Hispanic Blacks (7%). Almost 68% had public insurance while 13% had commercial insurance. One in five (19%) was uninsured and most (55%) were at or below 138% of the federal poverty level. Almost half of the patients were smokers (49%).

Location of cannabis documentation in EHR

Cannabis use was reported most frequently in the social history portion of the EHR ($n = 71,660$). Cannabis-related diagnoses were recorded in the encounter list ($n = 25,616$) and problem list ($n = 11,536$) sections of the EHR. If cannabis use appeared in the problem list it sometimes also appeared in the encounter list

($n = 7,407$). Few patients ($n = 2,341$) had cannabis use reported in all three lists (social history, encounter list, and problem list).

Associations between cannabis use disorders and psychiatric disorders

The unadjusted odds of having a cannabis-related disorder recorded on the encounter or problem list within the EHR were higher for all patients with a psychiatric diagnosis of depressive disorder (OR = 1.69, CI: 1.58–1.80), anxiety disorder (OR = 1.67, CI: 1.58–1.76), bipolar disorder (OR = 1.63, CI: 1.51–1.75), schizophrenia (OR = 2.02, CI: 1.85–2.21), and/or PTSD (OR = 1.63, CI: 1.50–1.77). Table 2 summarizes the relative odds of a cannabis-related disorder for psychiatric disorders adjusted for patient characteristics. The odds of a patient having a recorded cannabis-related disorder attenuated in the presence of other patient features, but were still elevated for individuals with a diagnosis for depression (aOR = 1.08, CI: 1.04–1.13), individuals with an anxiety disorder (aOR = 1.16, CI: 1.11–1.21), patients with bipolar disorder (aOR = 1.16, CI: 1.10–1.23) and patients with a diagnosis of schizophrenia (aOR = 1.62, CI: 1.48–1.78). The adjusted odds of cannabis use disorder did not differ significantly for individuals with a diagnosis of PTSD.

Associations between cannabis-related disorder and patient characteristics

Males had lower odds of cannabis use being documented as a disorder, rather than as a part of their social history (aOR = 0.77, CI: 0.73–0.81). Relative to individuals whose first documentation of cannabis use during the study period was between 18 and 24 years of age, the odds of a diagnosed cannabis-related disorder increased for each group of older individuals with the highest odds associated with the ages of 55 to 64 (aOR = 2.00, CI: 1.79–2.23) and 65 and older (aOR = 3.95, CI: 3.45–4.52). Non-Hispanic Whites (aOR = 0.57, CI: 0.52–0.63), non-Hispanic Blacks (0.56, CI: 0.49–0.64), and other non-Hispanic patients (0.77, CI: 0.69–0.86) all had lower odds of having a documented cannabis-related disorder compared with Hispanic patients. Odds of cannabis-related disorder compared with cannabis use only reported in the social history increased steadily with more clinic visits. Opioid use disorders (aOR = 1.59, CI: 1.48–1.71), alcohol use disorders (aOR = 1.47, CI: 1.37–1.59) and other drug use disorders (aOR = 1.33, CI: 1.23–1.42) were associated with increased odds of having a cannabis-related disorder documented. Current smokers, however, were less likely to have a diagnosis of

Table 1. Characteristics of patients having cannabis use or cannabis use disorder documented in electronic health records.

	Total		Cannabis Use Disorder Documented		Cannabis Use Documented in Social History	
	N	%	N	%	N	%
Total Patients	101,405	100.0	29,745	29.3	71,660	70.7
Psychiatric diagnosis						
Depression	39,112	38.6	14,912	50.1	24,200	33.8
Anxiety	34,097	33.6	13,407	45.1	20,690	28.9
Bipolar	10,360	10.2	4365	14.7	5995	8.4
Schizophrenia	5452	5.4	3076	10.3	2376	3.3
PTSD	8232	8.1	3673	12.3	4559	6.4
Sex						
Female	46,391	45.7	15,019	50.5	31,372	43.8
Male	55,014	54.3	14,726	49.5	40,288	56.2
Age at first cannabis use documentation during study period						
18–24	16,903	16.7	3081	10.4	13,822	19.3
25–34	28,073	27.7	6522	21.9	21,551	30.1
35–44	18,317	18.1	5484	18.4	12,833	17.9
45–54	17,942	17.7	6159	20.7	11,783	16.4
55–64	14,844	14.6	5476	18.4	9368	13.1
65+	5326	5.3	3023	10.2	2303	3.2
Race/ethnicity						
Hispanic	12,402	12.2	5,115	17.2	7,287	10.2
NH White	70,016	69.0	18,572	62.4	51,444	71.8
NH Black	6635	6.5	2051	6.9	4584	6.4
NH Other	4502	4.4	1484	5.0	3018	4.2
Unknown	7850	7.7	2523	8.5	5327	7.4
FPL percentage¹						
> 138	13,116	12.9	3,104	10.4	10,012	14.0
≤ 138	55,456	54.7	15,447	51.9	40,009	55.8
Unknown	32,833	32.4	11,194	37.6	21,639	30.2
Clinic state¹						
CA	36,160	35.7	8,804	29.6	27,356	38.2
OR	51,011	50.3	18,403	61.9	32,608	45.5
WA	14,234	14.0	2,538	8.5	11,696	16.3
Primary insurance payer¹						
Private	13,465	13.3	2,470	8.3	10,995	15.3
Public	68,723	67.8	22,166	74.5	46,557	65.0
Uninsured	19,217	19.0	5,109	17.2	14,108	19.7
Substance use disorder						
Opioid	5,328	5.3	2,971	10.0	2,357	3.3
Alcohol	6,473	6.4	3,194	10.7	3,279	4.6
Other ²	13,355	13.2	6,395	21.5	6,960	9.7
Smoker	49,917	49.2	13,370	44.9	36,547	51.0
Number of visits over study period						
1–5	25,518	25.2	2,896	9.7	22,622	31.6
6–15	24,219	23.9	5373	18.1	18,846	26.3
16–45	26,067	25.7	8477	28.5	17,590	24.5
> 45	25,601	25.2	12,999	43.7	12,602	17.6

Notes: NH = non-Hispanic; PTSD = post-traumatic stress disorder; FPL = Federal Poverty Level.

^aAt last patient encounter in study period.

^aAt last patient encounter in study period.

^bContains use of sedatives, cocaine, hallucinogens, inhalants, other stimulants, use of more than one substance, and substances other than those listed.

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a cannabis-related disorder (aOR = 0.69, CI: 0.65– 0.73). Clinic state, insurance payer, and percent of federal poverty level were not significantly associated with the location of cannabis use documentation in a patient's EHR.

Heterogeneity of the association between cannabis-related disorders and psychiatric disorders by sex

Patient's sex significantly modified the relationship between cannabis-related disorders and diagnoses of depression (p -value < 0.01) and anxiety (p < .01) [Table 3]. For the model including the interaction between sex and depression, a diagnosis of depression was no longer associated with the odds of cannabis use

disorder for females (aOR = 1.01, CI: 0.96– 1.07) [Table 4]. The strength of the association increased slightly and remained significant for males (aOR = 1.15, CI: 1.09– 1.22). For the model including the interaction between sex and anxiety, the effect of an anxiety diagnosis on the documentation of a cannabis-related disorder was weaker for females (aOR = 1.09, CI: 1.03– 1.15) than for males (aOR = 1.23, CI: 1.16– 1.31).

Discussion

In this study of a large network of community health centers, we estimated the odds of a documented

Table 2. Odds ratios of a cannabis use disorder for patients with various psychiatric diagnoses adjusted for patient characteristics.

Patient Characteristics	OR	(95% CI)
Psychiatric Diagnosis		
Depression	1.08***	(1.04, 1.13)
Anxiety	1.16***	(1.11, 1.21)
Bipolar	1.16***	(1.10, 1.23)
Schizophrenia	1.62***	(1.48, 1.78)
PTSD	1.00	(0.94, 1.08)
Sex		
Female		REF
Male	0.77***	(0.73, 0.81)
Age at first cannabis use documentation during study period		
18–24		REF
25–34	1.37***	(1.26, 1.48)
35–44	1.60***	(1.46, 1.75)
45–54	1.77***	(1.60, 1.96)
55–64	2.00***	(1.79, 2.23)
65+	3.95***	(3.45, 4.52)
Race/ethnicity		
Hispanic		REF
NH White	0.57***	(0.52, 0.63)
NH Black	0.56***	(0.49, 0.64)
NH Other	0.77***	(0.69, 0.86)
Unknown	0.67***	(0.59, 0.76)
FPL percentage^a		
> 138		REF
≤ 138	1.00	(0.94, 1.06)
Unknown	1.15***	(1.06, 1.25)
Clinic state^a		
CA		REF
OR	1.29	(0.84, 1.98)
WA	0.76	(0.32, 1.81)
Primary insurance payer^a		
Private		REF
Public	1.04	(0.95, 1.14)
Uninsured	0.91	(0.82, 1.00)
Substance use disorder		
Opioid		REF
Alcohol	1.59***	(1.48, 1.71)
Other ^b	1.47***	(1.37, 1.59)
Other ^b	1.33***	(1.25, 1.42)
Smoker	0.69***	(0.65, 0.73)
Number of visits over study period		
1–5		REF
6–15	1.67***	(1.48, 1.89)
16–45	2.24***	(1.98, 2.54)
> 45	3.55***	(3.05, 4.14)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Multivariable GEE logistic regression with clustering by clinic and robust standard errors.

Notes:

OR = Odds ratio; NH = non-Hispanic; PTSD = post-traumatic stress disorder; FPL = Federal Poverty Level.

^{aa}At last patient encounter in study period.

^aAt last patient encounter in study period.

^{bb}Contains use of sedatives, cocaine, hallucinogens, inhalants, other stimulants, use of more than one substance, and substances other than those listed.

^bContains use of sedatives, cocaine, hallucinogens, inhalants, other stimulants, use of more than one substance, and substances other than those listed.

cannabis-related disorder among cannabis users comparing patients with documented psychiatric disorders versus those without psychiatric disorders. The analysis compared patients who had cannabis use recorded in the social history section of the EHR to patients with documentation of cannabis use in the encounter list or problem list. Among cannabis-using patients, odds of having a cannabis-related disorder rather than use recorded only in the social history were higher among those with a documented psychiatric disorder. The

Table 3. Adjusted odds ratios of cannabis use documentation including the interaction between sex and depression or anxiety.

Patient Characteristics	OR	(95% CI)	OR	(95% CI)
Psychiatric Diagnosis				
Depressive Disorder	1.01	(0.96, 1.07)	1.08***	(1.04, 1.13)
Anxiety Disorder	1.16***	(1.11, 1.21)	1.09**	(1.03, 1.15)
Bipolar	1.16***	(1.10, 1.23)	1.16***	(1.10, 1.23)
Schizophrenia	1.62***	(1.48, 1.77)	1.62***	(1.47, 1.77)
PTSD	1.01	(0.94, 1.08)	1.01	(0.94, 1.08)
Sex				
Female		REF		REF
Male	0.73***	(0.68, 0.78)	0.73***	(0.69, 0.78)
Depression*Sex Interaction				
Anxiety*Sex Interaction	1.14***	(1.06, 1.23)	–	–
	–	–	1.13***	(1.06, 1.22)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Multivariable GEE logistic regression with clustering by clinic and robust standard errors and adjustment by age at first report of cannabis use during study period, race/ethnicity, FPL percentage, primary insurance payer, clinic state, number of visits over the study period, substance abuse, and smoking status.

Table 4. Interpretations of the interactions between sex and depression or anxiety.

	OR	95% CI	p-value
Among females , odds of cannabis use disorder for patients with and without a depression diagnosis	1.01	(0.96–1.07)	0.69
Among males , odds of cannabis use disorder for patients with and without a depression diagnosis	1.15	(1.09–1.22)	< 0.01
Among females , odds of cannabis use disorder for patients with and without an anxiety diagnosis	1.09	(1.03–1.15)	0.03
Among males , odds of cannabis use disorder for patients with and without an anxiety diagnosis	1.23	(1.16–1.31)	< 0.01

relationship between psychiatric disorders and severity of cannabis use in the literature is largely consistent with the results from the current study (Brook et al. 2002; Hayatbakhsh et al. 2007; Hill, 2017). The relationship between a documented cannabis-related disorder versus cannabis use in the social history and schizophrenia was particularly striking.

A meta-analysis of longitudinal studies which examined the relationship between schizophrenia and cannabis use highlighted that psychotic symptoms and psychotic disorders were more commonly reported in regular cannabis users than in non-cannabis users (Moore et al. 2007). Likewise, a meta-analysis which reviewed 10 studies reporting on 66,816 individuals found an association between psychosis and cannabis use (OR = 3.9, CI: 2.84–5.34) among those with the most severe cannabis use compared to the non-users and a stronger association for those with a diagnosis of schizophrenia or psychotic disorders (Marconi et al. 2016). Our study, limited to patients with reported cannabis use, also found associations between psychiatric disorders and documented severity of cannabis use (diagnosis versus social history). The relationship between cannabis use and psychotic disorders is multi-faceted and the direction of the

relationship as well as the concept of causality is debated. Nevertheless, the findings from the current analysis corroborate the conclusion by the National Academies of Sciences, Engineering and Medicine that there is “substantial evidence of a statistical association between cannabis use and the development of schizophrenia or other psychoses with the highest risk among the most frequent users” (National Academies of Sciences, Engineering 2017, 295).

Our analysis indicates that those with a depression diagnosis in the EHR were more likely to have more severe cannabis use as determined by documentation of a cannabis-related disorder in the encounter or problem list. Findings from a meta-analysis by Lev-Ran et al. (2014) indicate similar modest associations (OR = 1.62, CI: 1.21– 2.16) for cannabis use and depression while Moore et al. (2007) found moderate associations between cannabis use and depression (OR = 1.49, CI: 1.15– 1.94). Results from the current study considered the relationship between documented anxiety disorders and cannabis use, suggesting an anxiety-related diagnosis was more likely to have cannabis use documented as a disorder rather than noted in their social history. Similar studies, however, suggest mixed results. A meta-analysis reported that cannabis use at baseline was significantly associated with the development of anxiety symptoms at follow up in five studies (OR = 1.28, CI: 1.06– 1.54) (Kedzior and Laeber 2014). A secondary analysis of data from the National Epidemiological Study of Alcohol and Related Conditions, conversely, found no association between cannabis use and an increased incidence of anxiety disorders in a sample of 34,653 adults across Waves 1 and 2 of a longitudinal study (OR = 1.0, CI: 0.8– 1.2) after adjustments (Blanco, Hasin, and Wall et al. 2016). There was, however, an association between cannabis use in wave 1 and increased incidence of social anxiety disorder in wave 2 (OR = 1.8, CI: 1.1– 2.8) (Blanco, Hasin, and Wall et al. 2016).

The relationship between cannabis use and bipolar disorder has attracted much less attention in recent literature and there is a limited amount of evidence that would indicate an association between cannabis use and bipolar disorder, particularly among regular users (National Academies of Sciences, Engineering 2017). A meta-analysis indicated a relationship between cannabis use and the initiation of manic symptoms in individuals who had not previously experienced the disorder (OR = 2.97, CI: 1.80– 4.90). However, the authors cautioned that their findings should be regarded as tentative due to low numbers in the studies within the analysis and lack of data on patient characteristics (e.g., age, gender) and mode of cannabis usage

(Gibbs et al. 2015). Furthermore, Feingold et al. (2015) showed that after adjustment for demographic and clinical variables, there was a moderate and non-significant relationship between cannabis use and the onset of bipolar disorder (OR = 1.17, CI: 0.65– 2.11). In the current study, there was a modest relationship between severity of cannabis use as documented in the EHR and bipolar disorder, although results from a review of these associations suggested the evidence is limited (National Academies of Sciences, Engineering 2017).

Although the OCHIN population of patients are primarily female, our study sample was predominantly male (OCHIN n.d.). A patient had to report some type of cannabis use to be included in the current study and because males are more likely to use cannabis than females in general (Hasin et al. 2016), our study disproportionality captured males. Recognizing this discrepancy, we modeled the interactions between sex and certain psychiatric disorders, namely depression and anxiety, as females present in clinical settings with these particular psychiatric health conditions more often than males (Kessler et al. 2003). We found significant interactions between sex and both depression and anxiety. The relationship between depression and cannabis-related disorder, moreover, was no longer relevant for females and the association with anxiety was attenuated. Most adults with a lifetime major depressive disorder (72.1%) also met the criteria for at least one other psychiatric disorder and, in more than half of those cases (59.2%), it was an anxiety disorder (Kessler et al. 2003). In adults with a current major depressive disorder, 50–67% were found to have a concurrent anxiety disorder (Fava et al. 2000; Lamers et al. 2011). In persons with a current anxiety disorder, 63% met criteria for a concurrent depressive disorder (Lamers et al. 2011). There is evidence that suggests that co-occurring levels of depressive and anxiety symptoms can interact with one another (Kircanski et al. 2017).

Our study has several limitations. It does not include an assessment of patients without documentation of cannabis use and does not assess the population rates of psychiatric disorders and cannabis use. The lack of systematic assessments could have resulted in underreporting and underdiagnosing among this patient population. The reported associations, consequently, need to be considered in the context of this limitation. The current study was not longitudinal and causality is unknown. While we assume that an ICD-9/10 diagnosis in the encounter or problem list is indicative of more problematic or severe cannabis use, screening and documentation of cannabis use is

not standardized across OCHIN clinics. Thus, problematic use could have been documented in the social history via text fields without an associated cannabis-related diagnosis. It is also possible that the relationship between severity of cannabis use and psychiatric disorders is related to selective screening and documentation. For example, substance use is often assessed prior to diagnosis of a psychiatric condition to rule out that the symptoms are substance-induced. More systematic evaluations of cannabis use would allow for more rigorous examination of these relationships.

A more focused recording of data in relation to cannabis use via diagnostic criteria facilitates analyses on the relationship between cannabis use and psychiatric health disorders. It is important to record the diagnosis of cannabis use via ICD-9 and 10 codes which indicate more harmful use of the drug. As cannabis use continues to rise, it is recommended that primary care providers routinely screen for, and document, cannabis-related disorders, and psychiatric disorders. Ideally, this would be followed by brief intervention and referral to treatment. For the majority of patients (70%) a record of cannabis use in the social history was unrelated to psychiatric diagnoses. Clinicians reviewing patient records should be more attentive to a potential for a cannabis use disorder if the patient history includes psychiatric disorders and the patient reports frequent cannabis use. The analysis also begins to lay a foundation for development of patient cannabis registries that include detail on the frequency, amounts, and types of cannabis used. These data are essential to addressing both the potential harms and benefits of cannabis use (Hoffman et al. 2017).

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