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Marijuana use and service utilization among adolescents 7 years post substance use treatment*

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Abstract

Background—In an environment of increasingly liberal attitudes towards marijuana use and legalization, little is known about long-term trajectories of marijuana use among clinical samples of adolescents, and how these trajectories relate to health services utilization over time.

Methods—Latent growth curve analysis was used to identify distinct trajectories of marijuana use in a clinical sample of adolescents (N=391) over 7 years post substance use treatment in an integrated health system. We examined psychiatric problems and polysubstance use associated with the identified trajectory groups using general linear models. Nonlinear mixed-effects logistic regressions were used to examine associations between health services use and the trajectory groups.

Results—We identified three marijuana use trajectory groups: 1) *Abstinent* (n=117); 2) *Low/Stable* use (n=174); and 3) *Increasing* use (n=100). Average externalizing and anxiety/depression scores were significantly lower over time for the *Abstinent* group compared to the *Increasing* and *Low/Stable* groups. The *Low Stable* and the *Increasing* group had fewer psychiatric visits over time ($p<.05$) and the *Low/Stable* group used more substance use treatment services over time compared with the *Abstinent* group ($p<.001$).

Conclusions—Treated adolescents showed distinct marijuana use patterns, one of which indicated a group of adolescents at risk of increased use over time. These individuals have greater psychiatric and polysubstance use over time, but may not be accessing needed services.

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Contributors

Dr. Campbell conducted the initial literature search and wrote the first draft of the manuscript. Ms. Kline-Simon conducted the statistical analyses and was responsible for writing the results. Drs. Campbell and Ms. Kline-Simon contributed to the literature search, interpretation of the results, and the writing of the introduction and conclusion. Dr. Sterling and Ms. Chi contributed to the writing of the introduction, methods, and conclusion. All authors edited the manuscript. All authors contributed to and have approved the final manuscript.

Conflicts

None.

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Keywords

Adolescents; marijuana; trajectories; service utilization; longitudinal

1. INTRODUCTION

Marijuana continues to be the most commonly used illicit substance by adolescents (Center for Behavioral Health Statistics and Quality, 2015; Johnston et al., 2016). In 2014, 7.9% of adolescents age 12-17 reported using marijuana in the past 30 days, corresponding to approximately 1.8 million U.S. adolescents (Center for Behavioral Health Statistics and Quality, 2015). Twenty percent of young adults age 18-25 report using marijuana in the past 30 days (Center for Behavioral Health Statistics and Quality, 2015). Recent national data on past month and annual adolescent marijuana use indicate that use has leveled off in recent years (Hughes et al., 2015; Johnston et al., 2016; National Institute on Drug Abuse, 2016), although one study showed that exclusive marijuana use (not including tobacco) by adolescents has more than doubled since 2007 (Rolle et al., 2015). At the same time, the percentage of high school seniors who perceive regular marijuana use as harmful has decreased from 52% in 2009 to 32% in 2015, as has their disapproval of occasional use from 66% in 2009 to 53% in 2015 (Johnston et al., 2016).

These shifts in attitude parallel the increasing normalization of marijuana use in the U.S., as medical marijuana and legal recreational use have become more widespread as state policy (Hasin et al., 2015; Pacek et al., 2015). There is considerable concern that these attitudes may presage future increases in adolescent use and disorders (Johnston et al., 2016; National Institute on Drug Abuse, 2014). Clinicians may also perceive marijuana to be less risky than other substances, as they are less likely to refer adolescents to substance use treatment for marijuana problems than for other illicit substances (Scott et al., 2004; Sterling et al., 2012). The rapidly changing policy environment for marijuana use makes examining factors associated with long-term use and ongoing care in clinical populations critical.

Perceived risk is decreasing even with more evidence of harms associated with adolescent marijuana use that include: developing other substance use disorders (Anderson et al., 2010; Blanco et al., 2016; Buu et al., 2014; Lee et al., 2010), lower educational achievement (Homel et al., 2014; Stiby et al., 2015), differences in adolescent brain development and cognitive function (Meier et al., 2012; Volkow et al., 2016; Winward et al., 2014), and a lower likelihood of achieving development milestones in emerging adulthood (Anderson et al., 2010).

The long-term course of adolescent marijuana use is variable; some adolescents mature out of use, others may continue to use infrequently, while others develop dependence (Lee et al., 2010; Schulenberg et al., 2005; Winters and Lee, 2008). Most long-term studies of adolescent marijuana use have focused on general population samples (Grevenstein and Kroninger-Jungaberle, 2015; Homel et al., 2014; Jackson et al., 2008; Passarotti et al., 2015; Swift et al., 2008). Few studies have examined trajectories of marijuana use in clinical samples of adolescent patients who have been treated for substance use disorders, particularly private populations.

Clinical samples of adolescents with marijuana use problems are complex, with high prevalence of polydrug use, and co-occurring physical and psychiatric comorbidities, which (Mertens et al., 2007; Sterling et al., 2004) place them at risk of poor outcomes. However, little is known about how these characteristics impact trajectories of use through the important time of emerging adulthood in treated samples. In addition, these high need groups may need care over time (Anderson et al., 2010); receipt of continued primary and specialty health services utilization post treatment is associated with improved substance use outcomes (Chi et al., 2011; Mertens et al., 2005; Proctor and Herschman, 2014).

The current study addresses these gaps by identifying trajectories of marijuana use and associated risk factors over a seven year follow-up, using a large, privately insured adolescent sample who received substance use treatment in a private, non-profit health care delivery system. We also examine if patients received psychiatric or substance use treatment services after their initial treatment episode, or if they used the Emergency Department (ED). Identifying characteristics of patients who improve over time, and whether they received important services, has important implications for treatment and patient outcomes in the context of a quickly changing environment for marijuana use.

2. METHODS

2.1 Study participants

Study participants were adolescents aged 13 to 17 who entered substance use treatment at Kaiser Permanente Northern California (KPNC), a private, integrated health plan (N=419). Adolescents may have been using alcohol and/or drugs; the sample was not limited to only patients who used marijuana. Participants completed self-administered baseline questionnaires at intake at 4 KPNC Chemical Dependency Recovery programs. The treatment programs at the four sites were similar. All offered a 1-year program, were abstinence based, intensive, structured outpatient treatments, with regular breathalyzer and urine screens. Programs required participation of a parent or guardian and provided group therapy, education, and relapse prevention; family therapy and individual counseling were also available as needed. Attendance at 12-step programs was expected and monitored. The program had 3 Phases: 1) 8 weeks of more intensive treatment; 2) 4 months of relapse prevention/continuing recovery; 3) 6 months of aftercare. Phone interviews were conducted by experienced interviewers at six months, 1, 3, 5 and 7 years after intake, with response rates of 92%, 92%, 85%, 84% and 87%, respectively. Institutional Review Board approval was received from the Kaiser Foundation Research Institute and the University of California, San Francisco.

2.2 Measures

2.2.1 Baseline demographic measures—Gender, age, and ethnicity (coded as white vs. other), as well as, psychiatric and substance use treatment prior to intake and the number of substance use dependence symptoms were recorded at the baseline interview.

2.2.2. Baseline marijuana use—An indicator variable for daily use was created based on the frequency of marijuana use (daily, 2 to 6 days per week, once a week, 2 or 3 days per

month, once per month, less than once per month, used only once, none) in the prior 6 months.

2.2.3. Follow-up marijuana use—At each follow-up time point (6 months, and 1, 3, 5, and 7 years), marijuana use was measured as the number of days using marijuana in the prior 30 days.

2.2.4 Psychiatric measures—Psychiatric problems were assessed using the Youth Self Report (YSR; Achenbach, 1991), a structured self-report instrument that measures child and adolescent competencies and problems in eight domains: Aggressive Behavior, Anxious/Depressed, Withdrawn, Attention Problems, Delinquent Behavior, Social Problems, Somatic Complaints, and Thought Problems. In this paper we examine the Externalizing Scale which is comprised of the Delinquent Behavior and Aggressive Behavior subscales and the Anxious/Depressed scale. The YSR is widely used and has demonstrated solid psychometric properties across a variety of adolescent and child populations (Achenbach, 1991; McConaughy and Achenbach, 2001; McConaughy et al., 1992; Rowe et al., 2004; Sterling and Weisner, 2005).

2.2.5 Other substance use measures—Alcohol Use (yes/no), and Tobacco Use (yes/no) in the prior 30 days were measured at baseline and each follow-up. We created a measure of Other Illicit Drug Use (yes/no) which included any drug use excluding alcohol, marijuana and tobacco in the prior 30 days at baseline and each follow-up.

2.2.6 Health service use—Length of stay reflects number of days of the index substance use treatment episode, using electronic health record data. Health service measures of post-index treatment reflect a combination of both KPNC and non-KPNC service use for ED, substance use, and psychiatric service utilization. KPNC data were obtained from the electronic health record; non-KPNC utilization was self-report at each follow-up. Indicator variables were created for all three services at each follow-up. These indicators specified any services use between follow-ups (e.g., any ED visits between the 6 month and 1-year follow-up resulted in a positive indicator for ED use at the 1-year follow-up).

2.3. Data analysis

2.3.1 Trajectories analysis—All analyses were conducted using SAS version 9.3; statistical significance was defined at $p < .05$. Distinct data-based marijuana use trajectories were estimated over 7 years using a series of latent class growth analyses (LCGA) to fit 2-, 3-, 4-, and 5-class models via SAS procedure PROC TRAJ. PROC TRAJ fits a group-based model to identify clusters of individuals who follow similar patterns of marijuana use over time. Indicators of time (6 months, and 1, 3, 5, and 7 years) and the continuous measure of number of days used marijuana in the prior 30 days at each time point were used to estimate latent marijuana use trajectories. Selection of the optimal number of classes was guided by the Bayesian Information Criterion (BIC), commonly used as a fit statistic for LCGA models (Nagin, 2005; Nylund et al., 2007; Tofighi and Enders, 2008; Yang, 2006), as well as the interpretability of the classes identified (Jung and Wickrama, 2008; Nagin, 2005). Posterior probabilities of group membership were also used to examine the classification quality of

the selected groups (Andruff et al., 2009). Indicator variables were created for each of the marijuana use trajectory groups.

PROC TRAJ allows all subjects with at least one observation to be included in the analyses. However, to be conservative, we defined the analytic sample as patients with at least 2 follow-ups during the 7-year period (n=391). Including patients with at least 2 follow-ups provides more information to determine the trajectory groups and does not overly restrict the sample by only including those who completed all 5 interviews (n=279). To examine attrition, we compared the analytic sample (N=391) to those not included (N=28) in the analyses from the full sample (n=419). There were more women (35.3% vs. 17.9%; $p=0.0281$) and longer index treatment length of stay (mean [SD]=75.7 days [86.2 days] vs. 42.2 [41.8]); $p=0.0420$) in the analytic sample. There were no other significant differences.

2.3.2 Baseline characteristic analyses—Differences in baseline characteristics across the marijuana use trajectory groups were examined using chi-square tests for categorical and analysis of variance (ANOVA) for continuous variables.

2.3.3 Psychiatric severity and other substance use analyses—Associations between psychiatric severity and other substance use at each follow-up (i.e., externalizing scores, anxiety/depression scores, alcohol use, tobacco use and illicit drug use) and marijuana trajectories were examined with general linear models for continuous variables and logistic regression models for dichotomous variables; all models adjusted for age, gender, ethnicity, length of stay, number of baseline substance use dependence symptoms, and prior psychiatric and substance use treatment. Graphs of model-adjusted averages and odds ratios by the marijuana use trajectory groups across time points were created to illustrate the findings.

2.3.4 Utilization analyses—We fit 3 nonlinear mixed-effects logistic models to examine associations between health service utilization (ED, substance use treatment, and psychiatric services) and marijuana use trajectories by using PROC NLMIXED. For each outcome, we first estimated a simple logistic regression model without accounting for correlation between error terms. The parameter estimates from this initial model were used as starting values for the nonlinear mixed model procedure to ensure convergence of the likelihood function during estimation. The mixed-effects logistic model was then fit with these values using a random intercept. Interactions between time and the marijuana use trajectory group indicators were modeled to examine trends in utilization over time by marijuana use trajectory group; time was modeled as a continuous variable.

In these models, the intercept represents the value of the outcomes (e.g., odds of an ED visit) at initial status (i.e., 6 months post-treatment) for the reference group. The main effect for time represents the linear time effect for the reference group. The coefficients for the marijuana use trajectory groups represent the value of the model outcome (e.g., odds of an ED visit) for that marijuana use trajectory group compared to the reference group at the initial time point (6 months). The interaction terms of marijuana use trajectory groups by time indicate differences in utilization trajectories by marijuana use trajectory group from 6 months to 7 years post-intake, controlling for baseline characteristics, and time-varying

measures of externalizing scores, anxiety/depression scores, 30-day alcohol use, 30-day tobacco use and 30-day illicit drug use. To account for prior utilization and varying length of enrollment, we adjusted for utilization 1 year prior to treatment entry for each service examined and the percent of time participants were enrolled in the health plan over the 7-year period.

3. RESULTS

Forty-nine percent of the sample was white, the average age was 16 years, and 66% were male. At baseline, 91% of adolescents in the sample had used any marijuana in the prior 6 months. Using a dichotomized measure of any use in the prior 30 days, prevalence of marijuana use at each follow up was: 55% at 6 months, 47% at 1 year, 46% at 3 years, 51% at 5 years, and 54% at 7 years.

3.1. Marijuana use trajectories

We first conducted a series of LCGAs to fit 2-, 3-, 4-, and 5-class models. Comparisons of BIC values across these models (Table 1) suggested a 4-class model as the best-fit. However, one of the four classes contained only 2% of the sample, which did not allow for any meaningful follow-up analyses; therefore a 3-class model was determined to be the best fit. After determining the optimal number of classes, we re-fit the 3-class models with various shapes of the trajectory curves and selected the final model based on comparisons of BIC values (not shown) and posterior probabilities, which suggested good classification of the final trajectories identified (i.e., average posterior probabilities of group membership $>.80$) (Table 2). The three marijuana use trajectory groups identified were: 1) *Abstinent* (29.9%; $n=117$), abstinent from marijuana over time (reference group), 2) *Low/Stable* use (44.55%; $n=174$), steady marijuana use at low rates over time, 3) and *Increasing* use (25.6%; $n=100$), marijuana use increasing over time (Figure 1). The *Low/Stable* group used marijuana an average of 5 days per month over the 7 year period while the *Increasing* group used an average of 7 days at the 6 month follow-up and increased to an average of over 25 days per month by the 7 year follow-up.

3.2. Baseline patient characteristics by marijuana use trajectory group

Those in the *Increasing* group were more likely to be heavy users of marijuana at baseline (56% daily users in the prior 6 months at intake) than those in the *Abstinent* group or *Low/Stable* group (36% and 42%, respectively; $p<.05$). There were significantly less women in the *Increasing* group (19%) than in the *Abstinent* (43%) or *Low/Stable* (40%; $p<.001$) groups. Those in the *Low/Stable* and *Increasing* groups had, on average, higher anxiety/depression scores ($p<.05$), with the *Low/Stable* group having the highest mean score among the 3 groups. Although non-significant, higher proportions in these two groups reported alcohol and tobacco use in the 6 months prior to baseline than the *Abstinent* group. Significantly fewer participants in the *Abstinent* group used illicit drugs at baseline compared with the other two marijuana groups (28% *Abstinent*, 40% *Low/Stable*, 42% *Increasing*, $p<.05$). There were no significant differences between the other baseline characteristics and the marijuana use trajectory groups (Table 3).

3.3 Psychiatric severity and other substance use by marijuana use trajectory group

We examined associations between psychiatric severity (externalizing and anxiety/depression scores) and other substance use (alcohol, tobacco and illicit drug use) with the marijuana use trajectories over 7 years adjusting for patient characteristics (Figures 2, 3, 4, and 5). (Supplemental Table 1¹ shows unadjusted frequencies of other substance use over time). Due to the low frequency of use, we were unable to fit a model on illicit drug use over time (not shown). The average externalizing scores decreased over time for the *Abstinent* group and increased for the *Increasing* group, peaking at the 3-year follow-up. *Low/Stable* and *Increasing* groups had significantly higher externalizing scores than the *Abstinent* group across all follow-ups beginning at 1 year (p 's <.05; Figure 2). Similarly, those in the *Abstinent* group had a decreasing average anxiety/depression score over time which was significantly lower than both the *Low/Stable* and *Increasing* groups at the 5- and 7-year follow-ups (p 's <.05; Figure 3).

The *Increasing* group had significantly higher odds of alcohol use than the *Abstinent* group across all time points (p 's <.05, Figure 5). The *Low/Stable* group only differed from the *Abstinent* group in alcohol use at the 1- and 7-year follow-ups (p 's <.05). Tobacco use was similar across the groups over time with the exception of the 1- and 7-year follow-ups where the *Low/Stable* and *Increasing* groups, respectively, had higher odds of tobacco use compared with the *Abstinent* group (Figure 5).

3.4. Health service use models

Table 4 presents the models examining the relationships between the marijuana use trajectory groups and health service utilization. Time was significant in all models, indicating the *Abstinent* group had a declining trend in psychiatric and substance use treatment service use and an increasing trend in ED use over time. The *Low/Stable* group main effect was significant and positive in the ED model and significant and negative in the substance use treatment model, indicating that at 6 months the *Low/Stable* group had higher odds of ED visits and lower odds of substance use treatment compared with the *Abstinent* group. There were no significant differences between the marijuana use trajectory groups in ED use over time.

The interaction terms indicated that the *Increasing* and *Low/Stable* groups had decreasing odds of psychiatric visits over time (p 's <.05), and the *Low/Stable* group had increasing odds of substance use treatment visits over time (p <.001) compared with the *Abstinent* group.

4. DISCUSSION

Marijuana is the illicit drug most commonly used by adolescents and young adults, and its use, particularly long-term use, has been found to be associated with a host of health, psychiatric and social problems (Silins et al., 2014). Attitudes and laws around marijuana use are changing, particularly for this younger population, with more acceptance and fewer perceived harms (National Institute on Drug Abuse). It is critical in this environment to

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better understand the course of marijuana use among treated adolescents and young adults over time. This study is the first, to our knowledge, to examine 7-year trajectories of marijuana use among a sample of privately insured young adults who entered substance use treatment as adolescents. Over 90% were using marijuana at baseline and a majority continued to use 7 years after treatment. Marijuana use was reported at its lowest level at 3 years, but had returned to approximately 6-month levels by year 7.

We identified three longitudinal patterns of marijuana use over 7 years: *Abstinent*, *Low/Stable* use, and *Increasing* use. Our *Increasing* group experienced a considerable increase in marijuana use from 6 months post-intake, and leveling off at year 5. A majority of this group were high users at treatment intake, suggesting they had returned to pretreatment levels of use. Using other illicit substances at baseline was associated with being in the *Low/Stable* or *Increasing* groups; fewer patients in the *Abstinent* group had used other illicit substances at baseline. However, many in the *Abstinent* group were heavy marijuana users at baseline but were able to successfully maintain abstinence from marijuana over 7 years, as measured in the prior 30 days at each follow-up. Identifying factors associated with continued recovery among former users can be important for developing timely interventions.

We found fewer marijuana use trajectories than the existing research, although there are similarities. Chung et al. (2008) followed adolescents three years post treatment and identified six trajectories of marijuana dependence symptoms. Our *Low/Stable* group is similar to Chung et al.'s *Stable Low* group, with our longer time frame showing this stable trajectory can persist up to 7 years. We had a higher percentage in our *Increasing* group than Chung et al.'s (2008) increasing group, which may be due to our measures of use rather than dependence symptoms. We also note that our descriptive data show marijuana use to be the lowest at the three years post-treatment, which is consistent with the improved outcomes that Chung et al. found at three years. Our patterns were also similar to Anderson et al.'s 10 year post treatment study (Anderson et al., 2010) of treated adolescents, with our *Increasing* group being similar to their *Chronic group*, and our *Abstinent* group being similar to their *Abstainers/infrequent* group. Although they examined combined alcohol and drug use trajectory classes, they specifically highlighted marijuana use within those classes.

Despite the growing perception among adolescents that marijuana use is not problematic (Johnston et al., 2016), our findings show complex problems for this patient population. Those in the *Low/Stable* and *Increasing* groups reported higher externalizing scores over time starting at the 1 year follow-up and also had higher anxiety/depression scores at 5 and 7 years compared with the *Abstinent* group. These two use groups also were more likely to use alcohol over time. The higher levels of psychiatric symptoms may have led to or resulted from marijuana use, and the two types of problems – marijuana use and emotional distress – may have exacerbated the other. Given the greater acceptability of marijuana use, its increasing availability due to changing marijuana legislation, and a growing harm reduction perspective in the substance use treatment field, monitoring problems over the long-term is critical. These findings underscore the need for substance use screening among patients with psychiatric symptoms in particular, and for screening for psychiatric problems among marijuana users and those in substance use treatment.

It is important to highlight that although those in the use groups exhibited more problems and reported more emotional distress than abstainers, they were not necessarily more likely to use services. Individuals in the *Increasing* group reported higher psychiatric severity but were less likely to receive psychiatry services over time than the *Abstinent* group. Individuals in the *Low/Stable* group were also less likely to receive psychiatry services over time, although they had increasing odds of receiving substance use treatment over time, perhaps due to use of alcohol or other illicit drugs. The *Increasing* group did not demonstrate increased use of substance use treatment over time. The lack of psychiatry and substance use services utilization for those in the heaviest marijuana use trajectory group raises important questions about potential barriers to access for these patients and suggests that they may not be receiving the care they need, as observed in other studies (Anderson et al., 2010; Chung et al., 2008). This has important implications for models of integrated, continuing care in specialty and primary care. To serve these higher severity patients, successful models may include regular screening and monitoring in primary care for substance use, with referral to specialty treatment as needed. Higher psychiatric severity may also make it more difficult to attend structured substance use programs, thus access to dual diagnosis programs is also important.

The study has limitations. Although a strength is its private adolescent treatment sample, findings may not be generalizable to public patient populations. As with all observational (Feingold et al., 2014) studies, our results cannot be interpreted as causal. The current analysis uses the classical three-step approach to create the trajectory groups, which may underestimate the associations between the latent classes and observed covariates (Feingold et al., 2014). Future research applying modern methods of either single-step or new three-step approaches to examine the research questions is needed. The analytical sample had more women, and a longer length of stay. As with any longitudinal study there was some sample attrition which may result in bias; however, attrition analyses found no significant differences in attrition between the trajectory groups. We also note that our abstinence measure of marijuana use was based on the prior 30 days at each follow-up and did not restrict the use of other substances; findings should be understood in that context.

Treated adolescents showed distinct patterns over seven years that indicate a group of adolescents at risk of continued and increasing use, and that these individuals have greater psychiatric and polysubstance use over time. At the same time, these higher risk patients may not be accessing needed services, even in an integrated health care delivery system where health insurance coverage is not a barrier to care. Findings in this setting are particularly relevant in an era of health reform with more health systems becoming integrated, and with substance use treatment now an essential benefit. How to link these individuals to ongoing care in the health system remains a critical question for their long-term outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Three marijuana use trajectories were identified in a clinical sample of adolescents.
- There was a group at risk of increasing use over time.
- Those who continued to use marijuana were at higher risk of psychiatric problems.
- Those with increasing marijuana use did not use more services over time.

Figure 1.
Marijuana Use Trajectories (N=391), Days of Use in Past 30 Days

Figure 2.
Adjusted Average Externalizing Score over Time by Marijuana Use Trajectories (N=391)

Figure 3.
Adjusted Average Anxiety/Depression Score over Time by Marijuana Use Trajectories
(N=391)

Figure 4.
Adjusted Odds Ratios of Alcohol Use in Prior 30 days over Time by Marijuana Use Trajectories (N=391)

Figure 5.

Adjusted Odds Ratio of Tobacco Use in Prior 30 days over Time by Marijuana Use Trajectories (N=391)

Note: † *Low/Steady* and *Abstinent* groups significantly differ at $p < 0.05$; ‡ *Increasing* and *Abstinent* groups significantly differ at $p < 0.05$; Figures 2-5 adjust for patient demographics, indicators of CD and psychiatric treatment pre-intake, and the number of substance use dependence symptoms.

Table 1

Model Fit Criterion for Marijuana Use Trajectories Over Time (N=391)

Model	Number of groups	BIC	$2(\text{BIC}_t - \text{BIC}_{t-1})$
1	2	-2940.00	--
2	3	-2938.47	3.06
3	4	-2935.99	4.96
4 *	5	-2952.03	-32.08

Note: Among those with 2+ follow-ups between 1 and 7 years; BIC=Bayesian Information Criteria;

* indicates singular convergence error

Table 2

Average Posterior Probability of Marijuana Use Trajectory Membership by Trajectory Assignment (N=391)

Probability Conditional on Group Membership	Assignment Group		
	Abstinent	Low/Stable Use	Increasing Use
Abstinent	81%	11%	0%
Low/Stable Use	19%	81%	12%
Increasing Use	0%	8%	88%
Total	100%	100%	100%

Table 3

Baseline Patient Characteristics by Marijuana Use Trajectories (N=391)

	Abstinent (n=117)	Low/Stable Use (n=174)	Increasing Use (n=100)
Women (%) **	43	40	19
Age, mean(SD)	16.1 (1.3)	16.0 (1.2)	16.2 (1.3)
White (%)	54	44	53
Psychiatry treatment prior 12 months, (%)	22	23	22
Substance use treatment prior 12 months, (%)	12	17	14
Number substance use dependence symptoms, mean (SD)	4.2 (3.0)	4.6 (3.3)	4.7 (3.5)
Daily marijuana use in prior 6 months (%) *	36	42	56
% time enrolled in health plan, mean (SD)	67.7(29.7)	70.2 (30.5)	72.1 (30.1)
Externalizing score, mean (SD)	19.4 (9.2)	20.5 (9.6)	19.9 (8.8)
Anxiety/depression score, mean (SD) *	7.5 (5.9)	8.0 (6.2)	6.3 (5.7)
Alcohol use prior 6 months (%)	80	86	88
Illicit drug use prior 6 months (%) *	28	40	42
Tobacco use prior 6 months (%)	73	76	77
Length of stay, mean (SD)	83.0(88.8)	72.6(80.2)	72.7(88.8)

*
p<.05;**
p<.01

Logistic Models of Emergency Department Visits, Psychiatric Services and Substance Use Treatment Services Over 7 Years Post Intake (N=391)

Table 4

	Emergency Department			Psychiatric Services			Substance Use Treatment		
	Coefficient	SE	p-Value	Coefficient	SE	p-Value	Coefficient	SE	p-Value
Intercept	-2.20	1.08	0.0419	2.26	1.47	ns	1.11	0.88	ns
Time	0.29	0.05	<.0001	-0.14	0.05	0.0105	-0.57	0.06	<.0001
Low/Stable	0.52	0.27	0.0456	0.40	0.29	ns	-0.38	0.19	0.0450
Increasing	0.15	0.31	ns	0.12	0.33	ns	-0.25	0.22	ns
Abstinent	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Low/Stable x time interaction	-0.07	0.06	ns	-0.14	0.07	0.0472	0.28	0.07	<.0001
Increasing x time interaction	-0.01	0.07	ns	-0.19	0.08	0.0236	0.12	0.08	ns

Note: All models adjust for patient demographics, indicators of CD and psychiatric treatment pre-intake, number of substance use dependence symptoms, length of stay in treatment, percent of time enrolled in the health plan over 7 years and time-varying measures including externalizing scores, anxiety/depression scores, 30-day alcohol use, 30-day tobacco use and 30-day illegal drug use