

Medical Marijuana Use Among Adolescents in Substance Abuse Treatment

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Objective: To assess the prevalence and frequency of medical marijuana diversion and use among adolescents in substance abuse treatment and to identify factors related to their medical marijuana use. **Method:** This study calculated the prevalence and frequency of diverted medical marijuana use among adolescents ($n = 164$), ages 14–18 years (mean age = 16.09, SD = 1.12), in substance abuse treatment in the Denver metropolitan area. Bivariate and multivariate analyses were completed to determine factors related to adolescents' use of medical marijuana. **Results:** Approximately 74% of the adolescents had used someone else's medical marijuana, and they reported using diverted medical marijuana a median of 50 times. After adjusting for gender and race/ethnicity, adolescents who used medical marijuana had an earlier age of regular marijuana use, more marijuana abuse and dependence symptoms, and more conduct disorder symptoms compared with those who did not use medical marijuana. **Conclusions:** Medical marijuana use among adolescent patients in substance abuse treatment is very common, implying substantial diversion from registered users. These results support the need for policy changes that protect against diversion of medical marijuana and reduce adolescent access to diverted medical marijuana. Future studies should examine patterns of medical marijuana diversion and use in general population adolescents. *J. Am. Acad. Child Adolesc. Psychiatry*, 2012;51(7):694–702. **Key Words:** medical marijuana, marijuana, diversion, adolescents, substance abuse treatment

Colorado is one of 16 states, along with the District of Columbia, that legalized marijuana for medicinal purposes. As of October 31, 2011, a total of 88,872 persons in Colorado held a valid registry identification card for medical marijuana,¹ and as of September 2010, approximately 40% of all the marijuana dispensaries in the U.S. reside in Colorado.² The vast majority of registered medical marijuana users are adults, as only 41 adolescents have been approved to receive medical marijuana in Colorado.¹ However, the widespread “quasi-legalization” of marijuana raises concerns about the diversion of marijuana to adolescents, similar to concerns raised about the diversion of prescription opiates.^{3,4} “Diversion” is the process in which a supply of marijuana recommended for one person is given, traded, or sold to someone else who is not a registered medical marijuana user. The

widespread use of medical marijuana provides an opportunity to study the potential diversion of medical marijuana to adolescents in Colorado, which may be a bellwether state in terms of potential diversion of medical marijuana.

In the Colorado 2000 election, Amendment 20, which allows a physician to recommend marijuana to individuals with debilitating medical conditions, was passed with 54% of the vote.^{2,5} As of January 31, 2009, the number of registered medical marijuana users was 5,051⁶; however, important changes occurred in 2009. In March 2009, federal policy shifted in states with legalized medical marijuana so that raids on distributors of medical marijuana ended.⁷ In July 2009, Colorado loosened restrictions on who could cultivate and distribute medical marijuana. These changes opened the doors for large-scale medical marijuana dispensaries, and the number of individuals who possessed a valid medical marijuana registry identification card underwent a sixfold increase between January 31, 2009 and November 30, 2009.^{6,8} Additional increases occurred, so currently 2.3% of Colorado's adult population possesses a medical marijuana registration.^{1,9}



This article is discussed in an editorial by Dr. Alessandra N. Kazura on page 667.



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A contentious debate exists regarding the influence of legalized medical marijuana on adolescents' perceptions and use of marijuana. One perspective centers on concerns that labeling marijuana as medicinal may increase its acceptability and reduce perceived riskiness of use, in addition to concerns that "quasi-legalization" will lead to more availability and widespread use. The other perspective asserts that legalizing medical marijuana does not change marijuana perceptions and use.

Some researchers have reported findings that support the first side of the debate. Cedrá *et al.* examined the relationship between states with and without legalized medical marijuana on rates of marijuana use and abuse/dependence among adults. Using 2004–2005 data from the National Epidemiologic Survey on Alcohol and Related Conditions, adults living in states with legalized medical marijuana had higher odds of marijuana use and marijuana abuse/dependence diagnoses than residents living in states without legalized medical marijuana; although, the higher odds of marijuana abuse/dependence diagnoses were accounted for by higher rates of marijuana use.¹⁰ A similar study among 12–17 year olds, using data from the National Survey on Drug Use and Health from 2002–2008, found that states with legalized medical marijuana had higher adolescent marijuana use and lower perceptions of riskiness of marijuana use in comparison to states without legalized medical marijuana.¹¹ In summary, some evidence suggests that legalized medical marijuana is associated with lower perceptions of riskiness and higher rates of marijuana use among adolescents.

Conversely, some studies have reported results that support the position that legalized medical marijuana has no effect on use of marijuana. An interrupted time-series study by Gorman and Huber examined whether or not medical marijuana laws affected the amount of marijuana use among arrestees and emergency department patients in five major cities. The authors did not find any significant differences comparing rates of marijuana use before versus after such laws were enacted so they concluded that medical marijuana laws did not appear to increase marijuana use.¹² Khatapoush and Hallfors examined attitudes and drug use among 16–25 year olds in California and 10 other states in 1995, 1997, and 1999. There was a significant decrease in perceived harm from marijuana use among Californian youths; however, marijuana use in the past month and in the past year and

other drug use in the past year did not significantly change over time. Therefore, the authors concluded that legalizing marijuana for medical purposes had little impact on marijuana use.¹³

There are limitations to the studies supporting both sides of the debate. States enacting medical marijuana laws are not selected at random. Thus, comparing states with and without such laws at a single point in time cannot determine causality. One possibility is that state level norms supportive of marijuana use may contribute to the enactment of laws to legalize medical marijuana^{10,11}; alternatively, medical marijuana may lead to more favorable attitudes about marijuana and higher rates of marijuana use. Another concern, given recent policy changes in 2009, is that more time may be needed to see how medical marijuana laws may impact use patterns; the effects of policy changes may not be immediate because legalization may increase access and availability of marijuana, which in turn, given time, affects use.¹³

Widespread legalized medical marijuana use is a relatively new phenomenon in Colorado because of recent policy changes; as a result, none of the above studies accounted for the policy changes that occurred during 2009. One study collected data since 2009 and examined medical marijuana diversion among adolescents in substance abuse treatment. In a clinical sample of 80 adolescents, Thurstone *et al.* found that 39 (48.8%) of the adolescents obtained marijuana from someone with a medical marijuana license. None of the adolescents were registered medical marijuana users. Compared with adolescents who never obtained marijuana from someone with a medical marijuana license, these adolescents were more likely to report very easy marijuana availability, friends who did not disapprove of regular marijuana use, and use of marijuana more than 20 times per month in the past year. They also had more substance use problems in comparison to adolescents who did not obtain marijuana from a registered medical marijuana user.¹⁴ One limitation of their study is that it examined whether or not an adolescent obtained marijuana directly from a registered medical marijuana user, whereas adolescents may obtain diverted medical marijuana a few to several transactions removed from the registered user. Therefore, their study may underestimate the true extent of medical marijuana diversion to adolescent patients.

There is a dearth of research on the prevalence and frequency of medical marijuana diversion among adolescent patients in substance abuse

treatment and clinicians have limited data regarding which adolescents will or will not use someone else's medical marijuana. The aims of this study were to determine the prevalence and frequency of medical marijuana diversion and use among clinically ascertained adolescents and to examine possible factors related to their medical marijuana use.

METHOD

Participants

Participants ($n = 164$) were part of an on-going genetic association study of adolescents' substance use disorders. The medical marijuana questions were added approximately 5 months after the study began in response to clinical reports that adolescents reported widespread diversion. Because of the rapidly evolving political and legal context of medical marijuana, this study is based on the first 11 months of medical marijuana data from the parent study.

The participants were consecutive admissions recruited from two adolescent substance abuse treatment programs in the Denver metropolitan area. The Division of Substance Dependence at the University of Colorado has outpatient, multisystemic therapy, as well as day and residential treatment programs. Most of the patients are referred by social services or juvenile justice for serious conduct and substance use disorders. The second outpatient adolescent treatment program is located at a safety-net hospital where half of the patients are referred from juvenile justice and the other half from primary care, schools, and self-referral. Both of the treatment programs consist of voluntary admissions, although many treatment referrals originate from social services or probation so treatment can be in lieu of other consequences. Inclusion criteria for the study were as follows: in treatment for substance use disorders; 14–18 years of age; $IQ \geq 80$; ever used marijuana; and valid written consent for 18 year olds and valid written assent for 14–17 year olds, as well as valid written consent from a parent or guardian. Exclusion criteria were as follows: psychosis; obvious intoxication; current risk of suicide, violence, or fire setting great enough to interfere with assessments or to endanger interviewers; and insufficient English skills for assenting/consenting or to complete the interview. The majority of clinical adolescents (approximately two-thirds) were eligible for the study. The reasons for being ineligible included having parents with insufficient English skills to consent, being unwilling to participate, being younger than 14 years old, and having an IQ less than 80.

Written informed consent or assent and parental consent were obtained from participants after a complete description of the study was provided. The data from the interviews are confidential and participants were monetarily compensated for their time. The study was approved by the Colorado Multiple Institutional Review Board.

Measures

Composite International Diagnostic Interview–Substance Abuse Module. The computerized Composite International Diagnostic Interview–Substance Abuse Module (CIDI-SAM) was designed to be administered by trained nonclinical interviewers and assesses substance use patterns, including onset, duration, and intensity of use. The CIDI-SAM provides *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (DSM-IV)¹⁵ symptom counts and abuse and dependence diagnoses for 11 categories of substances.^{16,17}

CIDI-SAM Supplement. The interviewer-administered, paper-and-pencil CIDI-SAM supplement was previously developed by this research group to examine experimentation with substances that were not used frequently enough to meet criteria in the CIDI-SAM.¹⁸ This supplemental questionnaire includes questions about lifetime use of any substance, age of initial and regular use of a substance, number of days a substance was used in the past 6 months, and two stem questions about medical marijuana: "Have you ever been evaluated for medical marijuana? If yes, did you obtain a Medical Marijuana Registry Identification Card?" and "Have you ever used medicinal marijuana when it was prescribed for someone else? If yes, how many times?" Answers from these two questions were combined to form the outcome variable, ever used medical marijuana.

Diagnostic Interview Schedule for Children—Version IV. The computerized Diagnostic Interview Schedule for Children—Version IV (DISC-IV) was created to be administered by trained nonclinical interviewers and provides DSM-IV recent and lifetime psychiatric symptoms and diagnoses, such as conduct disorder.^{19–21}

Conduct Disorder Supplement. The interviewer-administered, paper-and-pencil conduct disorder (CD) supplement was previously developed by this research group to determine the degree to which substance involvement may have contributed to participants' CD. Using items from the DISC-IV and CD supplement, a whole-life CD diagnosis and the number of whole-life CD symptoms (range, 0–15 symptoms) were calculated.

Perceived Riskiness of Occasional and Regular Marijuana Use. These two self-administered questions originated from the Monitoring the Future (MTF) project and asked how much people risk harming themselves (physically or in other ways) if they smoke marijuana occasionally and regularly.^{22,23} Each item had four response categories, ranging from no risk (reference category) to great risk. In addition to the annual MTF study, the perceived riskiness items were used in other studies involving adolescents.^{14,24}

Family Environment. The social or interpersonal environment of the family is measured by a self-administered, modified 20-item Family Environment Scale (FES).²⁵ The adolescents rated statements about how they view their family using a five-point scale,

ranging from strongly disagree to strongly agree. Modifications to the FES were made previously by this research group to simplify the wording of the items and to shorten the assessment battery. Five family environment subscales were selected that matched the needs of the parent study. The five selected and relevant dimensions of the family environment were as follows: familial cohesion; expressiveness; conflict; achievement orientation; and parental control.

Statistical Analyses

Data were edited and analyzed in SPSS, version 19 (SPSS Inc., Chicago, IL).²⁶ Descriptive analyses were completed to examine the prevalence and frequency of diverted medical marijuana use. Pearson χ^2 analyses, independent *t*-tests (Mann-Whitney U tests when data were not normally distributed), and multiple logistic regressions were completed to determine factors related to the outcome variable, medical marijuana use, which was dichotomized as using others' or their own medical marijuana versus no medical marijuana use. Specifically, Pearson χ^2 analyses and independent *t*-tests were completed to determine significant covariates (age, race/ethnicity, or gender) and to examine the unadjusted relationship between an independent variable and medical marijuana use. Separate multiple logistic regressions were completed for each of the thirteen independent variables, while adjusting for significant covariates. Alpha levels of 0.05 and two-sided tests were used to determine significance.

RESULTS

Of 164 adolescents, 73.8% had used someone else's medical marijuana. Adolescents who used diverted medical marijuana reported a range of use from 1 to 1,000 times, with a mean of 117.48 and a median of 50 times. Four adolescents were evaluated for a medical marijuana referral; however, only one obtained a registry identification card. Of the 122 adolescents who used medical marijuana, 80% were male, and a little over half (56%) were non-Hispanic white adolescents (Table 1). Both groups were on average 16 years old at the time of the interview, and they had first used marijuana at approximately 12 years of age. A few adolescents never used marijuana on a regular basis; two adolescents in the used medical marijuana group and four in the group that did not use medical marijuana. The majority of adolescents in both groups had a conduct disorder diagnosis (78.7% of those who used medical marijuana versus 66.7% of those who did not use medical marijuana). In addition, a greater percentage of adolescents who used medical marijuana had a

marijuana abuse or dependence diagnosis compared with those who did not use medical marijuana (89.3% versus 66.7%, respectively).

Because of significant demographic differences, the separate multiple logistic regression analyses adjusted for differences in gender and race/ethnicity. These results are displayed in Table 2. For each additional year that age of onset of regular marijuana use is delayed, the odds of using medical marijuana declines by 21%. This result is in agreement with the bivariate analyses in Table 1 in which adolescents who used medical marijuana were almost 1 year younger when they started to use marijuana on a regular basis, at least once per month, compared with adolescents who did not use medical marijuana. Bivariate analyses revealed that adolescents who used medical marijuana used marijuana an average of 21 days more in the past 6 months than adolescents who did not use medical marijuana. After controlling for adolescents' race/ethnicity and gender, this amounts to a small, marginally significant increase of 1% in the odds of using medical marijuana for every additional day of marijuana use in the past 6 months. There is a 16% increase in the odds of using medical marijuana for every additional conduct disorder symptom. On average, adolescents who used medical marijuana had an additional conduct disorder symptom in comparison to adolescents who did not use medical marijuana. For each additional marijuana abuse and dependence symptom, the odds of using medical marijuana are increased by 31%. On average, adolescents who used medical marijuana had two more marijuana abuse or dependence symptoms compared with adolescents who did not use medical marijuana.

DISCUSSION

This study found a very high prevalence and a high frequency of diverted medical marijuana use; nearly three-quarters of clinically ascertained adolescents reported using diverted medical marijuana a median of 50 times. The rate reported in this study is higher than the 48.8% reported by Thurstone *et al.*,¹⁴ which may be due to the different questions in each study. Another possible explanation is that diverted medical marijuana may be increasingly available to adolescents in substance abuse treatment as time progresses. Despite the between-study differ-

TABLE 1 Bivariate Analyses Comparing Adolescents Who Used Medical Marijuana With Those Who Did Not

Variable	Used Medical Marijuana n = 122 % (n) or mean (SD)	Did Not Use Medical Marijuana n = 42 % (n) or mean (SD)	Statistic	p Value
Gender				
Female	19.7 (24)	35.7 (15)		
Male	80.3 (98)	64.3 (27)	$\chi_1^2 = 4.44$	.035
Race/ethnicity ^a				
Non-Hispanic white	55.7 (68)	42.9 (18)		
Hispanic, any race	32.0 (39)	26.2 (11)	$\chi_2^2 = 7.70$	.021
American Indian/Alaska Native	0.8 (1)	0		
White	4.9 (6)	7.1 (3)		
More than one race	14.8 (18)	9.5 (4)		
Unknown/other	11.5 (14)	9.5 (4)		
Non-Hispanic, nonwhite	12.3 (15)	31.0 (13)		
American Indian/Alaska Native	1.6 (2)	7.1 (3)		
Asian	0.8 (1)	0		
Native Hawaiian or Other Pacific Islander	0	2.4 (1)		
Black or African American	5.7 (7)	7.1 (3)		
More than one race	3.3 (4)	11.9 (5)		
Unknown/other	0.8 (1)	2.4 (1)		
Age	16.05 (1.11)	16.19 (1.15)	$t_{162} = 0.70$	.483
Onset age of first marijuana use	12.42 (2.03)	12.93 (1.75)	$t_{162} = 1.46$	.147
Onset age of regular marijuana use	13.38 (1.84) n = 120	14.03 (1.68) n = 38	$t_{156} = 1.94$	.055
Number of days used marijuana in the past 6 months	102.72 (62.16)	81.55 (61.00)	U = 2037.00	.047
Number of marijuana abuse and dependence symptoms	5.52 (2.97)	3.29 (2.75)	$t_{162} = -4.29$	.0005
Marijuana abuse or dependence diagnosis				
Yes	89.3 (109)	66.7 (28)		
No	10.7 (13)	33.3 (14)	$\chi_1^2 = 11.68$	.001
Number of substance use disorders, no tobacco	2.50 (1.78)	2.02 (1.88)	U = 2061.00	.051
Number of conduct disorder symptoms	5.30 (2.89)	4.14 (2.83)	$t_{162} = -2.24$	.026
Conduct disorder diagnosis				
Yes	78.7 (96)	66.7 (28)		
No	21.3 (26)	33.3 (14)	$\chi_1^2 = 2.45$	.118
Perceived riskiness of occasional marijuana use				
Risk ^b	47.9 (57)	50.0 (21)		
Great risk	4.2 (5)	4.8 (2)		
Moderate risk	10.9 (13)	26.2 (11)	$\chi_1^2 = 0.06$	.815
Slight risk	32.8 (39)	19.0 (8)		
No risk	52.1 (62) n = 119	50.0 (21)		
Perceived riskiness of regular marijuana use				
Risk ^b	66.1 (78)	64.3 (27)		
Great risk	9.3 (11)	16.7 (7)		
Moderate risk	26.3 (31)	26.2 (11)	$\chi_1^2 = 0.05$	.831
Slight risk	30.5 (36)	21.4 (9)		
No risk	33.9 (40) n = 118	35.7 (15)		

TABLE 1 Continued

Variable	Used Medical Marijuana n = 122 % (n) or mean (SD)	Did Not Use Medical Marijuana n = 42 % (n) or mean (SD)	Statistic	p Value
FES				
Familial cohesion	14.14 (2.90) n = 119	14.01 (3.40) n = 41	$t_{158} = -0.24$	.811
Expressiveness	12.46 (2.70) n = 120	12.37 (2.71) n = 41	$t_{159} = -0.18$	.854
Conflict	10.57 (3.07) n = 119	10.54 (3.83) n = 41	$t_{58.73} = -0.04$	.965
Achievement orientation	13.63 (2.99) n = 119	14.38 (3.22) n = 40	$t_{157} = 1.34$	.183
Parental control	11.73 (2.34) n = 119	11.60 (2.47) n = 40	$t_{157} = -0.29$	.772

Note: FES = Family Environment Scale.
^aBecause of the small cell counts, the race/ethnicity variable was collapsed into three categories: non-Hispanic white; Hispanic, any race; and non-Hispanic, nonwhite.
^bAs a result of the expected cell count of <5 in Pearson χ^2 analyses, categories were recoded into no risk versus any risk including slight, moderate, or great risk.

ences, together these results suggest that medical marijuana may be quite easy for adolescents in substance abuse treatment to obtain.

A related concern is that most adolescents in this study perceived marijuana use as having slight or no risk. Across all of the adolescents, only 11.3% rated smoking marijuana regularly as a great risk; in contrast, national data from the 2010 MTF study found that 68% of 8th graders, 57.2% of 10th graders, and 46.8% of 12th graders perceived smoking marijuana regularly as a great risk.²⁷ Although not nationally representative, these results raise concerns that vulnerable adolescents may view marijuana as a “low risk” substance. With 155,747 adolescent admissions for substance abuse treatment in 2009 in the U.S., this subpopulation of adolescents may be at great risk for using diverted medical marijuana.²⁸

In addition, this study revealed that adolescents using medical marijuana reported a greater frequency of behaviors involving earlier age of regular marijuana use, more marijuana abuse and dependence symptoms, and more conduct disorder symptoms compared with adolescents who did not use medical marijuana, even after adjusting for gender and race/ethnicity. Adolescents who used medical marijuana had an earlier age of regular marijuana use compared with adolescents who did not use medical marijuana;

however, due to the cross-sectional study design, determining whether exposure to medical marijuana influenced the onset age of regular marijuana use is not possible. Even with this limitation, this result is concerning because prior studies have revealed that adolescents who initiate early marijuana use are at an increased risk for developing marijuana abuse and dependence diagnoses.²⁹⁻³² Unfortunately, these adolescents may already be on this trajectory, because they also reported more marijuana abuse and dependence symptoms. Thus, treatment providers must pay careful attention to this at-risk patient subgroup; however, the very high rate of diverted medical marijuana use among clinically ascertained adolescents suggests that this may be a universal concern in treatment settings.

Medical marijuana use has grown exponentially in Colorado in recent years, as a result of policy changes. The number of individuals who hold a valid registry identification card for medical marijuana in Colorado has increased more than 17 times (5,051 as of January 31, 2009 to 88,872 as of October 31, 2011).^{1,6} During this same time period, there has been a tenfold increase in adolescents (less than 18 years of age) who hold a valid registry identification card; though the number of adolescents holding such a card is

TABLE 2 Multiple Logistic Regression Results Comparing Medical Marijuana Use Among Adolescents, Adjusting for Race/Ethnicity and Gender

Independent Variables	B (SE)	AOR	95% CI for AOR	p Value
Onset age of first marijuana use	−0.16 (0.10)	0.86	0.70, 1.05	.133
Onset age of regular marijuana use	−0.24 (0.12)	0.79	0.62, 0.99	.039
Number of days used marijuana in the past 6 months	0.01 (0.003)	1.01	1.00, 1.01	.053
Number of marijuana abuse and dependence symptoms	0.27 (0.07)	1.31	1.13, 1.51	.0005
Number of substance use disorders, no tobacco	0.13 (0.12)	1.14	0.90, 1.43	.276
Number of conduct disorder symptoms	0.15 (0.07)	1.16	1.01, 1.33	.040
Perceived riskiness of occasional marijuana use				
Great risk	0.33 (0.94)	1.39	0.22, 8.82	.725
Moderate risk	−0.88 (0.52)	0.42	0.15, 1.14	.089
Slight risk	0.63 (0.49)	1.88	0.72, 4.86	.196
No risk	—	—	—	—
Perceived riskiness of regular marijuana use				
Great risk	−0.35 (0.61)	0.70	0.21, 2.31	.560
Moderate risk	0.08 (0.48)	1.08	0.42, 2.79	.873
Slight risk	0.37 (0.50)	1.44	0.54, 3.84	.464
No risk	—	—	—	—
FES				
Familial cohesion	0.0001 (0.06)	1.00	0.89, 1.13	.998
Expressiveness	0.03 (0.07)	1.03	0.90, 1.18	.703
Conflict	0.03 (0.06)	1.03	0.92, 1.15	.610
Achievement orientation	−0.06 (0.07)	0.94	0.83, 1.07	.368
Parental control	0.06 (0.08)	1.07	0.91, 1.25	.438

Note: AOR = adjusted odds ratio; CI = confidence interval; FES = Family Environment Scale.

modest (four adolescents as of January 31, 2009 to 41 adolescents as of October 31, 2011).^{1,6}

The results of this study, along with the findings of Thurstone *et al.*,¹⁴ support that adolescents in substance abuse treatment often and readily obtain diverted medical marijuana. This suggests that substantial diversion is occurring from adult registered users and that the current system does not adequately guard against diversion to adolescents. Although imperfect, for scheduled prescription medications, Colorado has a prescription drug monitoring program that allows physicians to access a database for a given patient showing all prescriptions for controlled substances dispensed to that patient. Patients also can only obtain a supply of such potentially abusable medications through a written physician's prescription. Unlike other Food and Drug Administration (FDA)-approved medications, once a patient receives a physician's recommendation to use marijuana and obtains a registry identification card from the Colorado Department of Public Health and Environment, that individual can go to a medical marijuana dispensary and purchase medical marijuana in different amounts and forms or grow his/her

own plants. Thus, the current system of legalized medicinal marijuana in Colorado is handled in a manner that is vastly different from Drug Enforcement Administration-scheduled prescription medications that are FDA approved.

In addition, best practice guidelines might aid physicians who register patients for medical marijuana to reduce potential negative consequences to both their patients and other community members, including adolescents. A few possible approaches include the following: physicians providing a recommendation for medical marijuana should carefully assess for possible risk of diversion; recommending physicians should discuss with their patients the seriousness of diversions and methods for reducing this risk, such as keeping a supply of medicinal marijuana in a safe place (e.g., a lockbox); and recommending physicians should have an ongoing relationship with patients and be knowledgeable about the amount of medical marijuana patients are purchasing and growing.

The results from this study suggest that medical marijuana diversion is a serious concern and that future policy and regulation changes regarding medical marijuana should account for this

important negative consequence of medical marijuana legalization in the state. Additional research needs to be completed to guide future policy and regulation changes. Currently, information is lacking on whether a small number of medical marijuana registered users are diverting medical marijuana to a broad network of adolescents or whether a large proportion of registered users are diverting their medical marijuana to a few adolescents. Depending on the outcome of the study, appropriate policy and regulation changes should be developed.

Although the results of this study raise important concerns about the very common and frequent use of diverted medical marijuana among adolescent patients in substance abuse treatment, the study must be viewed within the context of several limitations. First, the study is cross-sectional in nature and cannot determine causality. Because of this temporal bias, drawing conclusions about whether diverted medical marijuana use led to substance problems or those with earlier or greater problems were more likely to use diverted medical marijuana is not possible. Longitudinal studies would aid in understanding how medical marijuana may affect adolescent marijuana use. Second, this study cannot determine whether medical marijuana has had any effect on marijuana use among adolescents in the general population and future studies should focus on this important topic. Third, this study did not include detailed questions about the kind or proportion of medical marijuana adolescents used; therefore, the proportion of diverted medical marijuana that adolescents used may have been small or of different varieties (e.g., edible versus smoked). Similarly, there is no way to verify that adolescents used medical marijuana that originated from a medical marijuana dispensary. For instance, a marijuana dealer could market the marijuana as medicinal when this may not be true. Qualitative research should be completed to determine the type, amount, and source of the medical marijuana adolescents report using. Fourth, the present study and the study by Thurstone *et al.*¹⁴ recruited adolescent patients from the same treatment program for six months; consequently, a maximum of 31 adolescents may have completed both studies. The questions about medical marijuana use were different in each study and the assessments in the present study were more detailed and comprehensive than the assessments in the study by Thurstone *et*

al. Because of confidentiality, the actual number of participants in both studies is not known; however, the assessments and questions were different, so there should be minimal bias. Finally, because of different state laws regarding medicinal use of marijuana, the results in this study do not generalize to other states; however, the findings may be an indication of what may occur in a similar context.

In conclusion, diverted medical marijuana use among adolescent patients in substance abuse treatment is very common, and adolescents who used medical marijuana reported an increased level of deleterious behaviors. The number of times that adolescents used diverted medical marijuana included a wide range from 1 to 1,000 times with a median of 50 times, which suggests that most adolescent patients have used medical marijuana on multiple occasions. Recent policy changes have led to an explosion in the number of registered medical marijuana users in Colorado, and this study reveals that many high-risk adolescent patients have used diverted medical marijuana; the rate at which the general population adolescents use diverted medical marijuana is currently unknown. At this time, research is critically needed to better understand how medical marijuana laws will or will not affect availability, perceptions, acceptability, and use of marijuana among adolescent patients as well as general population adolescents. ☺

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