

# Marijuana Legalization and Youth

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abstract

Various states have legalized marijuana for medical purposes and/or decriminalized recreational marijuana use. These changes coincide with a decrease in perceived harmfulness of the drug and an increase in its use among youth. This change is of critical concern because of the potential harmful impact of marijuana exposure on adolescents. Marijuana use has been associated with several adverse mental health outcomes, including increased incidence of addiction and comorbid substance use, suicidality, and new-onset psychosis. Negative impacts on cognition and academic performance have also been observed. As the trend toward legalization continues, the pediatric community will be called on to navigate the subsequent challenges that arise with changing policies. Pediatricians are uniquely positioned to provide innovative care and educate youth and families on the ever-evolving issues pertaining to the impact of marijuana legalization on communities. In this article, we present and analyze the most up-to-date data on the effects of legalization on adolescent marijuana use, the effects of adolescent use on mental health and cognitive outcomes, and the current interventions being recommended for use in pediatric office settings.

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Dr Ladegard served as the solo first author and contributed to manuscript preparation; Drs Thurstone and Rylander contributed to manuscript preparation and also warrant authorship; and all authors reviewed and approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

**DOI:** <https://doi.org/10.1542/peds.2019-2056D>

Accepted for publication Jan 29, 2020

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

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**FINANCIAL DISCLOSURE:** The authors have indicated they have no financial relationships relevant to this article to disclose.

**FUNDING:** No external funding.

**POTENTIAL CONFLICT OF INTEREST:** The authors have indicated they have no potential conflicts of interest to disclose.

Marijuana is the most popular illicit substance in the United States, and adolescents and young adults are among the highest users of marijuana.<sup>1</sup> Policies regarding marijuana have been changing and evolving for the past 30 years. The 1970s introduced an early wave of statewide decriminalization legislation. Decriminalization refers to criminal penalties that are removed and replaced with civil penalties, such as fines or mandatory treatment.<sup>2</sup> Although decriminalization policies apply to the use of marijuana by adults, they may affect adolescents by increasing availability and access while decreasing perceptions of harm. These changes may then lead to increased adolescent use of marijuana.<sup>2</sup> Beginning in 1996, marijuana use was legalized for medical purposes in >30 states and the District of Columbia, suggesting a trend toward a more normative view of marijuana.<sup>3</sup> In 2014, Colorado became the first state to legalize recreational marijuana, and since then, 10 additional states have followed suit.<sup>3</sup> Evaluating and researching the effects of marijuana policies on adolescents is a public health priority because of the potential adverse outcomes marijuana can have on youth, including an increase in the use of marijuana and other substances, new-onset psychosis, suicidality, marijuana-related motor vehicle crashes, and neurocognitive decline over time, including educational underperformance.<sup>4-16</sup> As the movement of legalization continues to expand, pediatricians will be called on to provide care to youth who are at risk for potential adverse individual and public health outcomes. Our purpose in this article is to provide pediatricians with an overview of the epidemiology of marijuana use among youth before marijuana policies change and as they change, advance their knowledge on

how marijuana use impacts physical and psychological health in youth, and describe key strategies and interventions that pediatricians can use when evaluating youth in their offices.

### IMPACT OF MARIJUANA POLICY CHANGES ON YOUTH

The impact of policy changes on marijuana use among youth are mixed and present a complicated clinical picture. Understanding trends in marijuana use among American youth is an essential step toward developing healthy policy, adequate education, and targeted interventions to mitigate potential adverse health effects from marijuana use.

The nationwide prevalence of adolescent marijuana use increased rapidly and surpassed tobacco use prevalence between 2008 and 2011, with the prevalence of lifetime marijuana use rising by 21% and past-year marijuana use rising by 31%.<sup>17</sup> Nine percent of youth in grades 9 to 12 use marijuana daily or nearly every day, an increase of 80% since 2008.<sup>17</sup> In the national conversation regarding legalization, many legalization proponents portray marijuana use as harmless. Research has shown that perception of harm is a potential indicator of marijuana use and that a reduction of perceived harm is commonly associated with an increase in marijuana use.<sup>18</sup> A study that used Monitoring the Future data showed that eighth-grade students from schools located close to medical marijuana dispensaries (short traveling distance, <5 miles) were more likely to have recently used marijuana compared with those from schools located farther from dispensaries (>25 miles).<sup>19</sup>

The national trend of increased rates of adolescent marijuana use is clear; however, it is not clear whether this increase is due to changing marijuana policies. States with medical marijuana laws (MMLs) reported

higher average marijuana use and lower perception of risk by adolescents (8.68%) compared with states without MMLs (6.94%) during the period between 2002 and 2008.<sup>20</sup>

However, the states with MMLs already had higher use and lower perceptions of risk. Therefore, it is not clear that passing the MMLs in certain states actually increased use.<sup>20</sup> Longitudinal studies conducted on pre and postlegalized marijuana markets have shown few changes in use among youth, which suggests that differences between states with and without legalized nonmedical marijuana may be due to preexisting trends rather than policy changes.<sup>21</sup> It is possible that states with higher marijuana use and lower perceptions of risk are more likely to enact MMLs. This explanation is supported in the current analysis by the observation that among states that eventually enacted MMLs, use was higher and perceptions of risk were lower even before passage of MMLs.<sup>2</sup> These findings provide evidence for the importance of public education campaigns that typically accompany marijuana legislation to help inform communities of the risks and adverse outcomes of marijuana use.

Whether the passage of MMLs caused a direct increase in adolescent marijuana use, other studies have illustrated concerning outcomes for youth in general and African American youth specifically. Studies have found the frequency of marijuana use was significantly associated with the use of other illicit drugs, such as cocaine or crack and heroin, and this association was found to be particularly strong in adolescents.<sup>22</sup> Adolescents residing in states that have legalized medical marijuana were more likely to use cocaine or crack and heroin in the past 12 months; however, MML implementation was not associated with increased use of other illicit drugs or misusing prescription medications.<sup>23</sup> Another study that

used data from repeated cross-sectional US general population surveys during 2001 and 2002 compared with 2012 and 2013 showed that in adolescents, marijuana use increased in African Americans.<sup>24</sup> This is concerning because African American youth have decreased access to substance use treatment compared with white youth, and if they are able to access treatment, it is more likely to be through juvenile justice involvement.<sup>25</sup>

Unlike medical marijuana, recreational marijuana is only recently legal in 11 states, so evidence on its impact is limited. Both Colorado and Washington state have seen a decrease in the perceptions of harm from marijuana use; however, this has been an overall trend across the United States.<sup>26</sup> One study showed a significant decrease in the perceived harm associated with marijuana use and an increase in past-month marijuana use after the enactment of recreational marijuana legalization among students in eighth and 10th grades in Washington state but not in Colorado.<sup>21</sup> A longitudinal study of families that lived in Washington state for >1 generation found that after marijuana legalization, parents were 3 times more likely to say they would tolerate marijuana use compared with the previous generation, suggesting that changes in legal status can indeed impact risk perception.<sup>27</sup> Recent data published in the *Journal of the American Medical Association Pediatrics* showed no increase in teenaged marijuana use after marijuana medicalization and a possible decrease in use after recreational marijuana legalization.<sup>28</sup> However, interpretation of these results is limited by pooling states with different medicalization and legalization structures and by the findings discussed above that states with a high prevalence of use are more likely to legalize marijuana.

Changes in the legal status of marijuana have led to increased availability in many regions for adolescents.<sup>29</sup> There has been an increase in marijuana-related emergency and urgent care visits, for example, in the pediatric population in Washington state and Colorado since the commercialization of medical and recreational marijuana.<sup>29</sup> Despite several studies showing that adolescent use has not increased in states after medical and recreational marijuana legalization, marijuana is still the most commonly used illicit drug among adolescents.<sup>1</sup> Approximately 1.6 million adolescents used marijuana in the past month in 2016, which translates to 6.5% of the entire adolescent population.<sup>1</sup> According to the Monitoring the Future survey, high school students are using marijuana at higher rates than other drugs, whereas alcohol and illicit drug use, in general, have declined.<sup>30</sup> In addition, the perceived risk of marijuana use is at an all-time low, with only 20% of high school seniors perceiving marijuana use as harmful.<sup>30</sup> Evidence on the impact of marijuana legalization remains preliminary given that the regulation changes have only recently been implemented. Therefore, it is critical to continue researching this issue and monitor youth clinically for the negative consequences of marijuana on overall health and functioning.

#### **IMPACT OF MARIJUANA USE ON MENTAL HEALTH OUTCOMES**

Addiction, development of psychosis, and suicide are among the serious mental health concerns associated with adolescent marijuana use.

#### **Marijuana Use and Addiction**

An estimated 17% of youth who use marijuana develop a cannabis use disorder.<sup>31</sup> Symptoms of cannabis use disorder are similar to those of other substance use disorders, and the American Psychiatric Association

*Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* recognizes physical dependence.<sup>32</sup> Approximately two-thirds of youth who present for substance use treatment report physical dependence, including tolerance and withdrawal from the drug.<sup>33</sup> Symptoms of cannabis withdrawal include anxiety, feeling hot and cold, insomnia, irritability, mild tremors, restlessness, strange dreams, and weight loss. Symptoms start within 1 day of abstinence, peak on days 2 to 4, and last ~2 weeks. Early onset of marijuana use by 16 years of age predicts a 2.7-fold increased risk of developing a cannabis use disorder.<sup>34</sup> Adolescent use also predicts a two- to threefold increased risk of using other substances.<sup>35</sup>

#### **Marijuana Use and Development of Psychosis**

Marijuana intoxication may cause acute psychosis.<sup>36</sup> This effect may depend on the potency and amount that is ingested. Maximum blood concentration after consuming marijuana edibles occurs in ~2 hours.<sup>37</sup> Therefore, people may consume marijuana and not feel any effects initially. As a result, they may continue consuming and ultimately experience extreme paranoia and psychosis.<sup>38</sup> In addition, adolescent exposure to marijuana predicts up to a twofold increased risk of developing psychosis and schizophrenia in adulthood.<sup>35</sup> This finding has been replicated multiple times in large cohort studies controlling for multiple variables, including family history, psychosis preceding marijuana use, and intoxication at the time of final assessment. This finding is also dose dependent, meaning that the more marijuana to which youth are exposed, the greater the odds are of developing psychosis as an adult.<sup>35</sup>

#### **Marijuana Use and Suicide**

A recent study of 7805 dizygotic and 6181 monozygotic twins showed that among twins discordant for using 100

or more times in their life, the twin using marijuana was 2.1 times more likely to have a lifetime history of major depressive disorder, 2.6 times more likely to have a lifetime history of suicidal ideation, and 4.4 times more likely to have a lifetime history of a suicide attempt.<sup>39</sup> Of note, youth with onset of depression, suicidal ideation, or suicide attempt before marijuana use were not included in these analyses. A recent meta-analysis did not find a relationship between acute marijuana use and suicidal ideation or behavior but did find associations between chronic or heavy marijuana use and death by suicide (odds ratio [OR] = 2.56), suicidal ideation (OR = 2.53), and suicide attempt (OR = 3.2).<sup>40</sup>

### IMPACT OF MARIJUANA USE ON COGNITIVE OUTCOMES

Three principle concerns have been associated with marijuana use and cognitive outcomes in youth: negative impact on brain development, negative impact on cognition, and negative impact on academic performance.

#### Marijuana Use and Brain Development

During adolescence, the brain undergoes major brain maturation processes, including gray-matter reduction, myelination, rewiring, decrease in synapses and dendrites, and changes in the ratio of various neurotransmitters. Because the adolescent brain is still developing, adolescent marijuana use may be associated with enhanced negative effects on brain structure and function.<sup>41</sup> A more recent study revealed greater gray-matter volume in adolescents with only 1 or 2 instances of marijuana use in regions rich in cannabinoid receptor type 1 and cannabinoid receptor gene expression.<sup>42</sup> These regions include the bilateral medial temporal lobes as well as the bilateral posterior cingulate, lingual gyri, and

cerebellum.<sup>42</sup> These changes in gray-matter volume are associated with reduced performance on a perceptual reasoning index and generalized anxiety symptoms.<sup>42</sup>

#### Marijuana Use and Cognition

Marijuana intoxication causes impairments in attention, concentration, decision-making, impulsivity, and working memory.<sup>35</sup> In daily users, this impairment may last for up to 4 weeks after last use.<sup>35</sup> It appears that marijuana use of at least 4 days per week starting in adolescence and continuing into adulthood predicts a decline in IQ of up to 8 points.<sup>43</sup> This finding only applied to adolescent-onset, not adult-onset, users and did not change with a year of abstinence.<sup>43</sup> Frequency of use predicts decreased executive functioning and learning, especially for adolescents with initiation of use by 14 years of age.<sup>44</sup> Furthermore, weekly use compared with no marijuana use predicts deficits in executive functioning and verbal IQ for up to 30 days.<sup>45</sup>

#### Marijuana Use and Academic Performance

There is strong evidence that youth who use marijuana, on average, have less academic success.<sup>46,47</sup> For example, in a 10-year longitudinal study of 1265 youth in New Zealand, teenagers who used marijuana by 15 years of age were 3.6 times less likely to graduate from high school, 2.3 times less likely to enroll in college, and 3.7 times less likely to earn a college degree.<sup>46</sup> Furthermore, youth who use marijuana at least weekly, compared with those who do not use, are 60% more likely to drop out of high school.<sup>47</sup> School suspensions and expulsions for substance use further hinder graduation and academic performance. In 2009, the Colorado Department of Education reported a 40% increase in school suspensions and expulsions for substance use.<sup>48</sup> This increase has been sustained

despite efforts to reduce exclusionary discipline. One limitation of these data is that they include all substances. Future studies will hopefully track school suspension and expulsion rates by substance.

Other studies found significant positive associations between marijuana use during adolescence and later anxiety and depression, paralleled by academic unpreparedness, delinquency, and poorer academic performance.<sup>49</sup> The negative consequences of failing to complete schooling on outcomes later in life have also been demonstrated. Marijuana use before 21 years of age was associated with higher unemployment, welfare dependence, lower levels of income, lower satisfaction with relationships, and lower life satisfaction at 25 years of age.<sup>50</sup>

#### MARIJUANA USE AND DRIVING

Driving while impaired can result in automobile crashes, injuries, and death. The National Highway Traffic Safety Administration recommends not driving for at least 3 hours after smoking marijuana. Drivers who consume edibles may need to wait longer. One study examined the proportion of traffic fatalities nationally in which the driver tested positive for marijuana.<sup>51</sup> The study found significant increases in Colorado compared with nonmedical marijuana states starting in 2009. One limitation of the study is a lack of information on the amount of intoxication at the time of the crash. Therefore, conclusive data on the impact of legalization on traffic fatalities are still needed. However, recent evidence suggests that traffic fatalities related to marijuana use are increasing.<sup>51</sup> Therefore, teenagers and parents should be counseled to avoid driving within at least 3 hours of smoking marijuana and longer if edibles are consumed.

## EFFECTIVE INTERVENTIONS FOR MARIJUANA USE IN THE PEDIATRIC VISIT

The Screening, Brief Intervention, and Referral to Treatment approach is widely recommended as part of the routine visit in pediatric primary care.<sup>52</sup> Pediatricians should ask all patients about marijuana use during routine and preventive appointments as well as during nonpreventive appointments. The American Academy of Pediatrics policy statement on Screening, Brief Intervention, and Referral to Treatment suggests that adolescents be asked about their use of alcohol, tobacco, and other drugs every time they seek medical services.<sup>52</sup> Adolescents report a desire to discuss alcohol and drug use with their pediatricians but have apprehension about bringing up the topic.<sup>53</sup> Pediatricians have a unique opportunity to encourage teenagers to talk about substance use and guide them into treatment if warranted. When screening adolescents, using a validated tool is imperative because a large study found that pediatricians conducting informal screening identified only 63% of adolescents with substance use, with the lowest detection rates being observed for youth with the most serious substance use problems.<sup>54</sup> The Car, Relax, Alone, Forget, Friends, Trouble (also known as “CRAFFT”) Screening Test is a validated screening tool to identify problematic use and has been recently updated to include vaping and edibles as methods of administration of marijuana.<sup>55</sup> However, if pediatricians are limited by time, a single screening question (ie, “How often have you used marijuana over the past year?”) is as effective as the full screening test when triaging adolescents into 4 risk categories, including no risk (no history of use), mild risk (history of past-year use), moderate risk (history of monthly use), and severe risk (history of weekly use).<sup>56</sup> The

procedure used to screen teenagers may be important as well because evidence suggests that adolescents perceive computer-administered substance use screens to be more confidential than paper-and-pencil and/or interview screening formats and therefore may provide more valid and accurate responses on technology-based screens.<sup>57</sup>

For patients who report marijuana use, pediatricians should inquire about frequency and amount, tolerance and withdrawal symptoms, and attempts to reduce use and provide counsel about marijuana-related harms.<sup>58</sup> Pediatricians should offer all patients with problematic use brief advice and counseling while incorporating simple motivational interviewing (MI) techniques because preliminary research of brief interventions (BIs) for cannabis users has shown promising results.<sup>59</sup> At a 3-month follow-up, for example, teenagers who received a BI of MI reported less marijuana use, lower perceived prevalence of marijuana use, fewer friends who used marijuana, and lower intention to use marijuana in the next 6 months compared with teenagers assigned to usual care.<sup>59</sup> At first, this may seem impractical because of time constraints of clinical practice, but the use of computers to facilitate the process can increase the frequency and quality of brief advice from the physician with minimal time burden during the visit. One study, for example, used a brief advice system consisting of computerized screening and an educational component before the visit, which took 5 minutes of patient time, and provider advice during the visit, which took 2 to 3 minutes during the encounter.<sup>60</sup> This intervention resulted in reduced adolescent alcohol and marijuana use in Prague, with effects persisting through the 12-month study period.<sup>60</sup> Adolescent substance use education and personalized feedback are pillars of BI that have shown positive effects

for deterring substance use in multiple contexts, including schools and pediatric care.<sup>60</sup> A handful of studies on family-focused BI in high school settings and pediatric clinics demonstrated that BI incorporating caregivers has added value over adolescent-only BI.<sup>61</sup> This intervention may be ideal when families are involved; however, pediatricians should inform adolescent patients that they will maintain confidentiality. Adolescents are more likely to disclose substance use behavior with pediatricians when confidentiality is assured.<sup>62</sup>

An important issue in adolescent substance use is cooccurring psychiatric disorders, which present an opportunity for pediatricians to effectively intervene by treating these conditions. For example, the Cannabis Youth Treatment Study found that ~80% of youth had a cooccurring psychiatric disorder and 60% had a history of emotional, physical, or sexual abuse.<sup>63</sup> The prevalence of these conditions were found even with exclusion criteria that excluded youth with severe psychiatric and substance use disorders. Pediatricians can identify and treat comorbid depression, with data suggesting that fluoxetine may be a good first agent.<sup>64</sup> Although attention-deficit/hyperactivity disorder symptoms are not uncommon in adolescents with substance use disorder, and comorbidity is frequent, studies have not conclusively demonstrated the efficacy of atomoxetine.<sup>65</sup> There is empirical support that osmotic-release methylphenidate can lead to improvement in attention-deficit/hyperactivity disorder symptoms and a reduction in positive drug screen results.<sup>66</sup> However, addressing comorbidities will not cure the substance use disorder (including marijuana), so continual evaluation for relapses is a must.<sup>67-69</sup> Addressing cooccurring psychiatric problems may be a way for teenagers



without motivation to change to access care initially. In fact, baseline motivation for change does not predict adolescent substance treatment outcomes.<sup>70</sup> Therefore, engaging precontemplative teenagers in treatment can be a helpful intervention. Pediatricians should refer patients who are unable to reduce use or who are experiencing harms from marijuana use to substance use treatment while ensuring that those patients remain connected to primary care.<sup>71</sup>

### EFFECTIVE INTERVENTIONS AND TREATMENTS

Fortunately, adolescent substance use treatment after legalization is just as effective as it was prelegalization.<sup>72</sup> Universal prevention programs are frequently administered in school-based settings and provide all youth with education and substance-refusal skills.<sup>72</sup> The effect size of universal prevention programs is generally low. Despite the popularity of these programs due to their ability to reach a large number of students, there are only 3 universal prevention programs that have empirical support.<sup>72</sup> The first program is the Good Behavior Game, which is used to promote social and emotional learning for first- and second-grade students. The second program is the Unplugged program, which was designed in Europe to teach middle school students life skills related to substance use prevention. Finally, the Life Skills Program provides middle school students with general life skills, such as problem-solving and drug refusal. These skills are then reinforced with booster sessions in high school.

The research on selective and indicated prevention interventions for adolescent substance use is even more limited than the body of research on universal school-based prevention programs.<sup>72</sup> Among the selective intervention programs, there are 3 that have shown

promising outcomes. The first successful selective intervention is the Nurse-Family Partnership, which provides in-home educational and emotional support to new mothers.<sup>73</sup> This support has been shown to significantly reduce arrests, convictions, risky sexual behaviors, and substance use at 15 years of age. Another selective intervention program called Project Towards No Drug Abuse provides 6 weeks of 40- to 50-minute lessons in social skills.<sup>72</sup> This intervention can be delivered in school-based and other nonclinical settings. Although studies show it does not reduce marijuana use, it does seem to reduce use of substances other than tobacco and marijuana. Finally, MI is another promising selective intervention. For example, 1 to 3 sessions of MI for high school students using substances has been shown to reduce substance use compared with assessment only at 6-month follow-up.<sup>74</sup>

For youth with cannabis use disorder, cognitive behavioral therapy plus contingency management increased the proportion of youth achieving a month of abstinence by the end of treatment (from 31% to 53%) compared with youth who just received cognitive behavioral therapy alone.<sup>75</sup> Another study showed that the inclusion of contingency management with MI into adolescent marijuana treatment decreased the end-of-treatment frequency of marijuana use and related consequences while increasing the use of coping strategies and the pursuit of additional treatment. MI plus contingency management resulted in a significantly lower frequency of marijuana use initially at the end of treatment (8 weeks after baseline to the intervention) but not at follow-up 16 weeks after baseline.<sup>76</sup> Despite having effective treatments for adolescent substance use, access to treatment is a problem. For 1.2 million youth each year, substance dependence occurs in

youth <18 years of age. Of these, 1.1 million (92%) go untreated, most often because of a lack of access to care.<sup>77</sup> Access is even worse for African American and Latino youth, who are more likely to access treatment through juvenile justice involvement compared with white youth.<sup>25</sup> Providing treatment in nontraditional community settings, such as recreational centers, pediatric clinics, and schools, might be a way to improve access to care. In terms of access, the primary care setting presents a unique venue to intervene with adolescents who use substances because 62% of youth 14 to 17 years of age visit a physician at least once per year, and 83% of youth from this age group are seen at least once over a 2-year period.<sup>78</sup> During a time when marijuana policies continue to shift and youth continue to explore the use of substances, pediatricians are uniquely positioned to educate and positively intervene with youth using substances, thereby promoting health for vulnerable communities.

### CONCLUSION, GAPS, AND FUTURE DIRECTIONS

As the trend toward legalization evolves, the medical community will continue to see adverse health impacts on youth. Pediatricians will increasingly find themselves confronted with the challenges of treating this vulnerable population. We have attempted to summarize the key issues known to date as they relate to marijuana consumption and health outcomes. However, we must emphasize that long-term data on outcomes of early-onset marijuana use are still in their infancy, and there are still unknown factors. There does not seem to be a safe amount of marijuana for adolescents to consume, and some adolescents seem to be most vulnerable to marijuana's effects. Future studies are needed to identify populations that could be more at risk for psychiatric and

cognitive complications related to marijuana use.

What has been established is that marijuana use shows concerning associations with subsequent mental health problems, including depression, comorbid substance use, suicidality, and new-onset psychosis. Equally concerning are the associations of early-onset marijuana use with cognitive impairment and poor academic performance, rendering young adults at a disadvantage in achieving early-adult milestones, such as steady employment, stable relationships, and overall life satisfaction. Although there are evidence-based treatments for adolescent substance use disorders, there is always a need for improving outcomes by researching what may enhance current treatments even further, including medication-assisted treatments for adolescents using marijuana, family engagement strategies, and incorporating peer social networks. This latter treatment is the foundation for the program Sources of Strength, which has proven to reduce youth suicide in school settings.<sup>79</sup> Despite having efficacious treatments and interventions for adolescent substance use, there remains a huge gap in treatment availability. Consequently, youth experience delays in receiving treatment, which may promote greater severity of substance use as well as other externalizing symptoms, potentially resulting in greater difficulty in achieving remission of symptoms. Researching innovative strategies to improve access to care, such as providing substance use treatment in pediatric offices and schools, should be explored as a solution to promote a healthy and positive community for all youth and families. By providing education and advocacy, pediatricians have a unique opportunity and influential power to take the lead in creating innovative approaches and venues for care,

thereby improving futures and making significant public health gains for their communities.

#### ABBREVIATIONS

BI: brief intervention  
MI: motivational interviewing  
MML: medical marijuana law  
OR: odds ratio

#### REFERENCES

1. Center for Behavioral Health Statistics and Quality. Key substance use and mental health indicators in the United States: results from the 2015 national survey on drug use and health. HHS Publication No. SMA 16-4984, NSDUH Series H-51. 2016. Available at: <https://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs-2015/NSDUH-DetTabs-2015/NSDUH-DetTabs-2015.pdf>. Accessed April 29, 2019
2. Martins SS, Mauro CM, Santaella-Tenorio J, et al. State-level medical marijuana laws, marijuana use and perceived availability of marijuana among the general U.S. population. *Drug Alcohol Depend.* 2016;169:26–32
3. Procon.org. Legal medical marijuana states and DC. 2019. Available at: <https://medicalmarijuana.procon.org/legal-medical-marijuana-states-and-dc/>. Accessed August 31, 2019
4. Nussbaum A, Thurstone C, Binswanger I. Medical marijuana use and suicide attempt in a patient with major depressive disorder. *Am J Psychiatry.* 2011;168(8):778–781
5. Degenhardt L, Hall W, Lynskey M. Exploring the association between cannabis use and depression. *Addiction.* 2003;98(11):1493–1504
6. Lynskey MT, Glowinski AL, Todorov AA, et al. Major depressive disorder, suicidal ideation, and suicide attempt in twins discordant for cannabis dependence and early-onset cannabis use. *Arch Gen Psychiatry.* 2004;61(10):1026–1032
7. Pedersen W. Does cannabis use lead to depression and suicidal behaviours? A population-based longitudinal study.

*Acta Psychiatr Scand.* 2008;118(5):395–403

8. Rasic D, Weerasinghe S, Asbridge M, Langille DB. Longitudinal associations of cannabis and illicit drug use with depression, suicidal ideation and suicidal attempts among Nova Scotia high school students. *Drug Alcohol Depend.* 2013;129(1–2):49–53
9. van Ours JC, Williams J, Fergusson D, Horwood LJ. Cannabis use and suicidal ideation. *J Health Econ.* 2013;32(3):524–537
10. Price C, Hemmingsson T, Lewis G, Zammit S, Allebeck P. Cannabis and suicide: longitudinal study. *Br J Psychiatry.* 2009;195(6):492–497
11. Kim HS, Hall KE, Genco EK, Van Dyke M, Barker E, Monte AA. Marijuana tourism and emergency department visits in Colorado. *N Engl J Med.* 2016;374(8):797–798
12. Schimmelmann BG, Conus P, Cotton S, Kupferschmid S, McGorry PD, Lambert M. Prevalence and impact of cannabis use disorders in adolescents with early onset first episode psychosis. *Eur Psychiatry.* 2012;27(6):463–469
13. Ksir C, Hart CL. Cannabis and psychosis: a critical overview of the relationship. *Curr Psychiatry Rep.* 2016;18(2):12
14. Silins E, Swift W, Slade T, Toson B, Rodgers B, Hutchinson DM. A prospective study of the substance use and mental health outcomes of young adult former and current cannabis users. *Drug Alcohol Rev.* 2017;36(5):618–625
15. Hanna RC, Perez JM, Ghose S. Cannabis and development of dual diagnoses: a literature review. *Am J Drug Alcohol Abuse.* 2017;43(4):442–455
16. Sharma P, Murthy P, Bharath MMS. Chemistry, metabolism, and toxicology of cannabis: clinical implications. *Iran J Psychiatry.* 2012;7(4):149–156
17. The Partnership at DrugFree.org; MetLife Foundation. The Partnership Attitude Tracking Study: 2011 parents and teens full report. Available at: <https://drugfree.org/wp-content/uploads/2012/05/PATS-FULL-Report-FINAL-May-2-PDF.pdf>. Accessed August 22, 2019

18. Johnston LD, O'Malley PM, Miech RA, Bachmen JG, Schulenberg JE. Monitoring the Future National Survey Results on Drug Use 1975-2016. 2017. Available at: <http://monitoringthefuture.org/pubs/monographs/mtf-overview2016.pdf>. Accessed August 23, 2019
19. Shi Y. The availability of medical marijuana dispensary and adolescent marijuana use. *Prev Med*. 2016;91:1-7
20. Wall MM, Poh E, Cerdá M, Keyes KM, Galea S, Hasin DS. Adolescent marijuana use from 2002 to 2008: higher in states with medical marijuana laws, cause still unclear. *Ann Epidemiol*. 2011;21(9):714-716
21. Cerdá M, Wall M, Feng T, et al. Association of state recreational marijuana laws with adolescent marijuana use. *JAMA Pediatr*. 2017; 171(2):142-149
22. Golub A, Johnson BD. The shifting importance of alcohol and marijuana as gateway substances among serious drug abusers. *J Stud Alcohol*. 1994; 55(5):607-614
23. Wong SW, Lin HC. Medical marijuana legalization and associated illicit drug use and prescription medication misuse among adolescents in the U.S. *Addict Behav*. 2019;90:48-54
24. Hasin DS, Shmulewitz D, Sarvet AL. Time trends in US cannabis use and cannabis use disorders overall and by sociodemographic subgroups: a narrative review and new findings. *Am J Drug Alcohol Abuse*. 2019;45(6): 623-643
25. Alegria M, Carson NJ, Goncalves M, Keefe K. Disparities in treatment for substance use disorders and co-occurring disorders for ethnic/racial minority youth. *J Am Acad Child Adolesc Psychiatry*. 2011;50(1):22-31
26. Keyes KM, Wall M, Cerdá M, et al. How does state marijuana policy affect US youth? Medical marijuana laws, marijuana use and perceived harmfulness: 1991-2014. *Addiction*. 2016;111(12):2187-2195
27. Kosterman R, Bailey JA, Guttmanova K, et al. Marijuana legalization and parents' attitudes, use, and parenting in Washington state. *J Adolesc Health*. 2016;59(4):450-456
28. Anderson DM, Hansen B, Rees DI, Sabia JJ. Association of marijuana laws with teen marijuana use: new estimates from the youth risk behavior surveys [published online ahead of print July 8, 2019]. *JAMA Pediatr*. doi:10.1001/jamapediatrics.2019.1720
29. Wang GS, Davies SD, Halmo LS, Sass A, Mistry RD. Impact of marijuana legalization in Colorado on adolescent emergency and urgent care visits. *J Adolesc Health*. 2018;63(2):239-241
30. Johnston LD, O'Malley PM, Miech RA, Backman JG, Schulenberg JE. Monitoring the Future national survey results on drug use: 1975-2014: Overview, key findings on adolescent drug use. 2015. <http://www.monitoringthefuture.org/pubs/monographs/mtf-overview2014.pdf>. Accessed August 23, 2019
31. Hall W, Degenhardt L. Adverse health effects of non-medical cannabis use. *Lancet*. 2009;374(9698):1383-1391
32. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, 5th ed. Washington, DC: American Psychiatric Association; 2013
33. Vandrey R, Budney AJ, Kamon JL, Stanger C. Cannabis withdrawal in adolescent treatment seekers. *Drug Alcohol Depend*. 2005;78(2):205-210
34. Swift W, Coffey C, Carlin JB, Degenhardt L, Patton GC. Adolescent cannabis users at 24 years: trajectories to regular weekly use and dependence in young adulthood. *Addiction*. 2008;103(8): 1361-1370
35. Levine A, Clemenza K, Rynn M, Lieberman J. Evidence for the risks and consequences of adolescent cannabis exposure. *J Am Acad Child Adolesc Psychiatry*. 2017;56(3):214-225
36. D'Souza DC, Perry E, MacDougall L, et al. The psychotomimetic effects of intravenous delta-9-tetrahydrocannabinol in healthy individuals: implications for psychosis. *Neuropsychopharmacology*. 2004;29(8): 1558-1572
37. Borgelt LM, Franson KL, Nussbaum AM, Wang GS. The pharmacologic and clinical effects of medical cannabis. *Pharmacotherapy*. 2013;33(2):195-209
38. Vo KT, Horng H, Li K, et al. Cannabis intoxication case series: the dangers of edibles containing tetrahydrocannabinol. *Ann Emerg Med*. 2018;71(3):306-313
39. Agrawal A, Nelson EC, Bucholz KK, et al. Major depressive disorder, suicidal thoughts and behaviours, and cannabis involvement in discordant twins: a retrospective cohort study. *Lancet Psychiatry*. 2017;4(9):706-714
40. Borges G, Bagge CL, Orozco R. A literature review and meta-analyses of cannabis use and suicidality. *J Affect Disord*. 2016;195:63-74
41. Jacobus J, Tapert SF. Effects of cannabis on the adolescent brain. *Curr Pharm Des*. 2014;20(13):2186-2193
42. Orr C, Spechler P, Cao Z, et al. Grey matter volume differences associated with extremely low levels of cannabis use in adolescence. *J Neurosci*. 2019; 39(10):1817-1827
43. Meier MH, Caspi A, Ambler A, et al. Persistent cannabis users show neuropsychological decline from childhood to midlife. *Proc Natl Acad Sci USA*. 2012;109(40):E2657-E2664
44. Castellanos-Ryan N, Pingault JB, Parent S, Vitaro F, Tremblay RE, Séguin JR. Adolescent cannabis use, change in neurocognitive function, and high-school graduation: a longitudinal study from early adolescence to young adulthood. *Dev Psychopathol*. 2017; 29(4):1253-1266
45. Scott JC, Slomiak ST, Jones JD, Rosen AFG, Moore TM, Gur RC. Association of cannabis with cognitive functioning in adolescents and young adults: a systemic review and meta-analysis. *JAMA Psychiatry*. 2018;75(6):585-595
46. Fergusson DM, Horwood LJ, Swain-Campbell NR. Cannabis dependence and psychotic symptoms in young people. *Psychol Med*. 2003;33(1):15-21
47. Silins E, Fergusson DM, Patton GC, et al; Cannabis Cohorts Research Consortium. Adolescent substance use and educational attainment: an integrative data analysis comparing cannabis and alcohol from three Australasian cohorts. *Drug Alcohol Depend*. 2015;156:90-96
48. Colorado Department of Education. Suspension and expulsion statistics.



Available at: [www.cde.state.co.us/cdereval/suspend-expelcurrent](http://www.cde.state.co.us/cdereval/suspend-expelcurrent). Accessed April 29, 2019

49. D'Amico EJ, Tucker JS, Miles JN, Ewing BA, Shih RA, Pedersen ER. Alcohol and marijuana use trajectories in a diverse longitudinal sample of adolescents: examining use patterns from age 11 to 17 years. *Addiction*. 2016;111(10):1825–1835
50. Fergusson DM, Boden JM. Cannabis use and later life outcomes. *Addiction*. 2008;103(6):969–976; discussion 977–978
51. Salomonsen-Sautel S, Min SJ, Sakai JT, Thurstone C, Hopfer C. Trends in fatal motor vehicle crashes before and after marijuana commercialization in Colorado [published correction appears in *Drug Alcohol Depend*. 2014;142:360]. *Drug Alcohol Depend*. 2014;140(140):137–144
52. Levy SJ, Williams JF; Committee on Substance Use and Prevention. Substance use screening, brief intervention, and referral to treatment. *Pediatrics*. 2016;138(1):e20161211
53. Ford CA, Millstein SG, Halpern-Felsher BL, Irwin CE Jr.. Influence of physician confidentiality assurances on adolescents' willingness to disclose information and seek future health care. A randomized controlled trial. *JAMA*. 1997;278(12):1029–1034
54. Wilson CR, Sherritt L, Gates E, Knight JR. Are clinical impressions of adolescent substance use accurate? *Pediatrics*. 2004;114(5). Available at: [www.pediatrics.org/cgi/content/full/114/5/e536](http://www.pediatrics.org/cgi/content/full/114/5/e536)
55. Knight JR, Sherritt L, Shrier LA, Harris SK, Chang G. Validity of the CRAFFT substance abuse screening test among adolescent clinic patients. *Arch Pediatr Adolesc Med Care*. 2000;38(1):7–18
56. Levy S, Weiss R, Sherritt L, et al. An electronic screen for triaging adolescent substance use by risk levels. *JAMA Pediatr*. 2014;168(9):822–828
57. Pedersen ER, Grow J, Duncan S, Neighbors C, Larimer ME. Concurrent validity of an online version of the Timeline Followback assessment. *Psychol Addict Behav*. 2012;26(3):672–677
58. Turner S, Spithoff S, Kahan M. Approach to cannabis use disorder in primary care: focus on youth and other high-risk users. *Can Fam Physician*. 2014;60(9):801–808, e423–32
59. D'Amico EJ, Miles JN, Stern SA, Meredith LS. Brief motivational interviewing for teens at risk of substance use consequences: a randomized pilot study in a primary care clinic. *J Subst Abuse Treat*. 2008;35(1):53–61
60. Harris SK, Csémy L, Sherritt L, et al. Computer-facilitated substance use screening and brief advice for teens in primary care: an international trial. *Pediatrics*. 2012;129(6):1072–1082
61. Gayes LA, Steele RG. A meta-analysis of motivational interviewing interventions for pediatric health behavior change. *J Consult Clin Psychol*. 2014;82(3):521–535
62. Ford C, English A, Sigman G. Confidential health care for adolescents: position paper for the society for adolescent medicine. *J Adolesc Health*. 2004;35(2):160–167
63. Dennis M, Godley SH, Diamond G, et al. The Cannabis Youth Treatment (CYT) Study: main findings from two randomized trials. *J Subst Abuse Treat*. 2004;27(3):197–213
64. Hinckley JD, Riggs P. Integrated treatment of adolescents with co-occurring depression and substance use disorder. *Child Adolesc Psychiatr Clin N Am*. 2019;28(3):461–472
65. Thurstone C, Riggs PD, Salomonsen-Sautel S, Mikulich-Gilbertson SK. Randomized, controlled trial of atomoxetine for attention-deficit/hyperactivity disorder in adolescents with substance use disorder. *J Am Acad Child Adolesc Psychiatry*. 2010;49(6):573–582
66. Riggs PD, Winhusen T, Davies RD, et al. Randomized controlled trial of osmotic-release methylphenidate with cognitive-behavioral therapy in adolescents with attention-deficit/hyperactivity disorder and substance use disorders. *J Am Acad Child Adolesc Psychiatry*. 2011;50(9):903–914
67. Riggs PD. Treating adolescents for substance abuse and comorbid psychiatric disorders. *Sci Pract Perspect*. 2003;2(1):18–29
68. Perkonig A, Goodwin RD, Fiedler A, et al. The natural course of cannabis use, abuse and dependence during the first decades of life. *Addiction*. 2008;103(3):439–449; discussion 450–451
69. Brown SA, Tapert SF, Tate SR, Abrantes AM. The role of alcohol in adolescent relapse and outcome. *J Psychoactive Drugs*. 2000;32(1):107–115
70. Yeterian JD, Greene MC, Bergman BG, Kelly JF. Does mandated treatment benefit youth? A prospective investigation of adolescent justice system involvement, treatment motivation, and substance use outcomes. *Alcohol Treat Q*. 31(4):431–449
71. Ozechowski T, Becker SJ, Hogue A. SBIRT-A: adapting SBIRT to maximize developmental fit for adolescents in primary care. *J Subst Abuse Treat*. 2016;62:28–37
72. LeNoue SR, Riggs PD. Substance abuse prevention. *Child Adolesc Psychiatr Clin N Am*. 2016;25(2):297–305
73. Olds DL. The nurse-family partnership: an evidence-based preventive intervention. *Infant Ment Health J*. 2006;27(1):5–25
74. Winters KC, Leitten W. Brief intervention for drug-abusing adolescents in a school setting. *Psychol Addict Behav*. 2007;21(2):249–254
75. Stanger C, Ryan SR, Scherer EA, Norton GE, Budney AJ. Clinic- and home-based contingency management plus parent training for adolescent cannabis use disorders. *J Am Acad Child Adolesc Psychiatry*. 2015;54(6):445–453.e2
76. Stewart DG, Felleman BI, Arger CA. Effectiveness of motivational incentives for adolescent marijuana users in a school-based intervention. *J Subst Abuse Treat*. 2015;58:43–50
77. US Department of Health and Human Services. Results from the 2010 National Survey on Drug Use and Health: Summary of National Findings. 2010. Available at: <https://>

www.samhsa.gov/data/sites/default/files/NSDUHNationalFindingsResults2010-web/2k10ResultsRev/NSDUHresultsRev2010.pdf. Accessed August 24, 2019

78. O'Connor EA, Hollis JF, Polen MR, Lichtenstein E. Adolescent health care visits: opportunities for brief prevention messages. *Eff Clin Pract*. 1999;2(6):272–276

79. Katz C, Bolton SL, Katz LY, Isaak C, Tilston-Jones T, Sareen J; Swampy Cree Suicide Prevention Team. A systematic review of school-based suicide prevention programs. *Depress Anxiety*. 2013;30(10):1030–1045

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