Marijuana Legalization: Impact on Physicians and Public Health

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Abstract

Marijuana is becoming legal in an increasing number of states for both medical and recreational use. Considerable controversy exists regarding the public health impact of these changes. The evidence for the legitimate medical use of marijuana or cannabinoids is limited to a few indications, notably HIV/AIDS cachexia, nausea/vomiting related to chemotherapy, neuropathic pain, and spasticity in multiple sclerosis. Although cannabinoids show therapeutic promise in other areas, robust clinical evidence is still lacking. The relationship between legalization and prevalence is still unknown. Although states where marijuana use is legal have higher rates of use than nonlegal states, these higher rates were generally found even prior to legalization. As states continue to proceed with legalization for both medical and recreational use, certain public health issues have become increasingly relevant, including the effects of acute marijuana intoxication on driving abilities, unintentional ingestion of marijuana products by children, the relationship between marijuana and opioid use, and whether there will be an increase in health problems related to marijuana use, such as dependence/addiction, psychosis, and pulmonary disorders. In light of this rapidly shifting legal landscape, more research is urgently needed to better understand the impact of legalization on public health.

INTRODUCTION

Marijuana is the most commonly used illicit drug in the United States, with ~3.1 million individuals reporting daily use in the last year and 8.1 million individuals reporting using marijuana most days in the last month in 2013 (1). Marijuana has now been legalized for medical use in 23 states and the District of Columbia. The process of legalization of marijuana for medical use is substantially different from the approval of medications by the US Food and Drug Administration (FDA): Approval occurs by popular vote or the action of a state legislature, and is thus not subject to the higher standard of evidence required by the FDA for both efficacy and safety. As of April 2015, Colorado, Washington, Alaska, Oregon, and the District of Columbia have also legalized marijuana for recreational use, with other states likely to follow. At the federal level, however, marijuana remains illegal as a schedule I controlled substance, a category reserved for substances with a high potential for abuse, lack of established safety, and no accepted medical use.

The public health impact of marijuana legalization remains a controversial issue. Advocates of legalization contend that this policy change will provide for more stringent regulation and safer use of marijuana, more efficient use of law enforcement resources, and possibly even a decline in the prevalence of marijuana use among adolescents and of the use of "harder" drugs (e.g., cocaine and heroin) (2, 3). Those opposing legalization cite the adverse effects of marijuana and worry that legalization will lead to an increase in use, and thus an increase in health problems attributed to marijuana. The latter view is reflected in the official position statements of prominent professional medical associations such as the American Psychiatric Association, the American Society of Addiction Medicine, and the American Medical Association, which have expressed concern regarding the negative consequences of marijuana use. We review the potential impact of marijuana's legalization on public health as well as conditions for which marijuana or its constituents may be a legitimate treatment option.

OVERVIEW OF MARIJUANA

Unlike pharmaceutical medications, marijuana is not a single-agent compound but a complex combination of more than 100 different chemicals, which include cannabinoids, flavonoids, and terpinoids. The primary psychoactive component of marijuana is delta-9-tetrahydrocannabinol (THC). However, other cannabinoid compounds—including cannabidiol (CBD), cannabinol, cannabichromene, cannabidivarin, cannabigerol, and tetrahydrocannabivarin—have their own actions on the central nervous system and may modify the effects of THC ("entourage effects"). The concentration of these compounds can vary substantially (4), making it difficult to characterize the specific positive or negative health effects of marijuana, especially in uncontrolled and epidemiological studies. In addition, the average content of THC in marijuana (as measured in confiscated marijuana samples in the United States) has increased substantially from ~1% in the 1980s to ~9% in 2008 (5, 6). As THC is thought to be related to many of marijuana's adverse effects, this increase in potency means that relying on older studies for data about marijuana's safety profile may be problematic. Furthermore, given that individual cannabinoids present in whole-plant marijuana have different pharmacological effects, data on individual cannabinoids cannot necessarily be extrapolated to whole-plant marijuana and vice versa. More research is urgently needed in light of the changing legal landscape and the increasing potency of marijuana.

ROUTES OF ADMINISTRATION AND INDICATIONS

Marijuana is typically consumed via smoking of joints or blunts (dried marijuana leaves rolled into cigarettes or cigars, respectively). More recently, in an effort to avoid the potentially harmful

byproducts of burning marijuana, use of vaporizers has increased. Although this method of cannabis consumption may theoretically avoid the inhalation of toxins, rigorous clinical studies confirming its safety have not yet been done. When smoked or given intravenously, THC is rapidly absorbed, producing physical effects within minutes. Oral doses delay the onset of effects by 30–120 min, produce lower and irregular peak plasma levels compared to smoked THC, and prolong the action of the drug (7). The inhaled route allows for real-time dose titration, whereas delayed onset with oral consumption means that the individual cannot reduce the dose once effects, including negative ones, emerge. Hence, individuals who are not familiar with the effects of THC or other cannabinoids may become overwhelmed by the effects of oral consumption.

Although marijuana remains illegal at the federal level, individual components of marijuana have been purified, tested, and approved by the FDA or similar regulatory agencies as medications for certain conditions. Oral THC is available as Dronabinol (Marinol®) and has been approved by the FDA for the treatment of HIV/AIDS cachexia (8, 9) and nausea/vomiting related to chemotherapy (10–12). Nabilone (Cesamet®) is an oral THC analog that is FDA-approved for the treatment of nausea/vomiting related to chemotherapy (13). Nabiximols (Sativex®) is an admixture of THC and CBD (approximately 1:1 ratio) in an oromucosal spray formulation; it has been approved by regulatory agencies in Canada and many countries throughout Europe to treat spasticity in multiple sclerosis (MS) (14, 15).

The list of qualifying conditions for which medical marijuana (most commonly consumed by smoking) is legal on the state level varies substantially (**Table 1**), as does the level of evidence for each condition (**Table 2**). Common conditions include pain, HIV/AIDS, cancer, glaucoma, epilepsy/seizures, nausea/vomiting, spasticity/MS, agitation in Alzheimer's disease, and posttraumatic stress disorder (PTSD). Although dronabinol and nabilone are both FDA-approved for HIV/AIDS cachexia and chemotherapy-related nausea/vomiting, it is not known whether marijuana is also efficacious for the treatment of these conditions. The numerous other compounds (i.e., cannabinoids, flavonoids, terpinoids) present in smoked or edible marijuana may interact with the actions of THC. Large randomized controlled trials (RCTs) have shown efficacy of nabiximols for MS-related spasticity, and at least two RCTs of smoked marijuana or an oral cannabis extract also show efficacy in this condition (16, 17). At least three RCTs (total n = 101), designed to test the efficacy of smoked marijuana for at least five days in treating neuropathic pain, have been positive (18–20), with additional evidence from challenge studies. Additionally, large trials testing the efficacy of nabiximols or an oral cannabis extract in neuropathic pain have also shown benefit (17, 21, 22). Robust clinical evidence (i.e., large RCTs) for other indications is generally lacking (**Table 2**). Preclinical research, however, is promising: cannabinoids have demonstrated anti-inflammatory (23) and anticonvulsant (24) properties. Furthermore, THC and CBD have been shown to enhance extinction learning, a process critical in the treatment of PTSD (39, 40). Evidence also suggests that cannabinoids may transiently lower intraocular pressure, suggesting promise in the treatment of glaucoma (41). However, further research is needed to examine whether these preclinical findings translate into clinical efficacy and to explore the potential risks of smoked or edible marijuana compared to oral/nasal cannabis extracts.

RELATIONSHIP BETWEEN LEGALIZATION AND PREVALENCE

As marijuana has well-documented adverse health effects (discussed below), one of the principal questions permeating the legalization debate is whether liberalized marijuana laws will lead to increased prevalence of use. Generally, US states that have legalized medical or recreational marijuana have higher rates of use than those where all forms of marijuana remain illegal (42–44). However, it is difficult to ascertain whether this is attributable to legalization or is associated with

Table 1 Common qualifying conditions in states with medical marijuana laws

Qualifying condition	State (standard US postal abbreviations)																							
	AK	AZ	CA[a]	CO	CT	DC	DE	HI	IL	MA[a]	MD	ME	MI	MN	MT	NH	NJ	NM	NV	NY	OR	RI	VT	WA
Cancer	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Glaucoma	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X		X
HIV/AIDS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cachexia	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		X	X		X	X	X	X
Pain	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Nausea	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		X	X	X	X	X	X	X
Seizures/ epilepsy	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Multiple sclerosis	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hepatitis C		X				X	X		X	X	X	X	X		X		X	X				X		
Crohn's disease		X			X				X	X	X	X	X		X	X	X	X		X		X		X
Agitation in Alzheimer's		X				X	X		X		X	X	X		X	X					X	X		
Amyotrophic lateral sclerosis		X				X	X		X	X		X	X	X	X	X	X	X		X				
Posttraumatic stress disorder		X			X		X					X	X					X	X		X			
Arthritis			X															X						
Parkinson's disease					X				X									X		X				

[a]Law allows physicians to recommend marijuana for any condition that they feel marijuana may help treat.

Table 2 Evidence supporting the use of marijuana/cannabinoids for selected conditions[a]

Agitation in Alzheimer's disease	Small RCT (N = 12) showed a decrease in agitation from dronabinol treatment, though sedation was a common side effect, suggesting a nonspecific effect (25) Long-term safety of psychoactive cannabinoids in demented patients is potentially problematic and has not been thoroughly evaluated
Cachexia/anorexia	Dronabinol is approved by the FDA for the treatment of cachexia in HIV/AIDS (8, 9) Large RCT (N = 243) comparing oral THC, oral cannabis extract, and placebo for the treatment of cancer-related cachexia showed no difference between treatment groups (26). Another large RCT (N = 469) showed oral THC is inferior to megestrol in cancer-related cachexia (27)
Crohn's disease	Small RCT (N = 21) showed no difference in remission but suggested symptomatic improvement in the group receiving active cannabis cigarettes; no objective measures (i.e., endoscopic biopsies) were evaluated (28) Although preclinical evidence suggests a possible anti-inflammatory role of cannabinoids (23), large RCTs have not established the efficacy of marijuana in Crohn's disease
Epilepsy	Three small RCTs (total N = 36) suggest cannabidiol may be useful in the treatment of epilepsy (29–31), but this evidence is insufficient to draw definitive conclusions of cannabidiol's long-term safety and efficacy (32). Larger RCTs evaluating efficacy or safety of marijuana/cannabinoids in epilepsy have not been done
Nausea/vomiting	Nausea and vomiting were among the first indications for which cannabinoids were approved for use. Dronabinol (oral THC) and nabilone (an oral THC analog) are approved by the FDA for the treatment of chemotherapy-induced nausea and vomiting (10–13)
Pain	Large and moderately sized RCTs have demonstrated the efficacy of nabiximols or an oral cannabis extract to treat neuropathic pain (21, 33, 34), although not all trials have been positive (NCT01606202; NCT00710424) Smaller trials of limited duration (5 days) have suggested that smoked marijuana may be efficacious in treating neuropathic pain (18–20) Preliminary data exist for rheumatoid arthritis (35), although less evidence exists for non-neuropathic pain
Posttraumatic stress disorder (PTSD)	A small RCT (N = 10) suggested that nabilone may improve nightmares in PTSD (36). Larger RCTs evaluating efficacy and safety of marijuana/cannabinoids in PTSD have not been done
Spasticity	Nabiximols is approved by regulatory agencies in Europe and Canada for the treatment of spasticity related to MS (37, 38) At least two RCTs show that smoked marijuana or an oral extract may be efficacious in the treatment of MS-related spasticity (16, 17)

Abbreviations: FDA, US Food and Drug Administration; MS, multiple sclerosis; RCT, randomized controlled trial; THC, tetrahydrocannabinol.
[a]Randomized controlled trials (placebo- or active-controlled), but not open-label or observational studies, are included as evidence.

regional variation in permissive attitudes or perceived risk with regard to marijuana (43). Indeed, legal-marijuana states generally have higher rates of use even before legalization (42, 43).

The prevalence of marijuana use in adolescents is a point of particular interest in the policy debate because many of the negative health effects of the drug (addiction/dependence, psychosis, cognitive impairment) are heightened when use begins in adolescence (45–47). Evidence also suggests that cannabis use in adolescence and early adulthood is associated with poor social outcomes, including unemployment, lower income, and lower levels of life and relationship satisfaction (48).

Decades' worth of data from the Monitoring the Future survey have shown a clear inverse relationship between risk perception and marijuana use among adolescents: the more risk attributed to marijuana, the lower the percent of use among young people (49). This relationship has also been seen among adults (50) and across age groups (51). It is feared that any decline in risk perception resulting from legalization will be followed by an increase in prevalence of use.

Despite these concerns, several studies have failed to find a measurable effect of legalization for medical use on adolescent prevalence using a pre–post analysis (43), a comparison with regionally proximate states (42), or a difference-in-differences analysis (52). Two of these studies, however, did not include data from marijuana-policy bellwether states such as Colorado, California, or

Washington (42, 52). Data from the Youth Risk Behavior Survey (sponsored by the Centers for Disease Control and Prevention) show an increase in youth rates of marijuana use (from 2011 to 2013) in New Mexico since medical marijuana was legalized in 2009, although this trend among adolescents has thus far not been found in other states (53).

In 2009, the Obama administration issued a memorandum (the Ogden Memo) which instructed prosecutors and law enforcement officials not to focus federal resources on individuals "whose actions are in clear and unambiguous compliance with existing state laws providing for the medical use of marijuana" (54), essentially decriminalizing medical marijuana use at the federal level. This policy shift was associated with a drastic increase in medical marijuana registration applications in Colorado (55); to our knowledge, this association has not been thoroughly evaluated in other states. As noted above, most studies in adolescents have found no measurable effect of state-level policy changes on marijuana prevalence (53); however, it is still too early to know the possible long-term consequences of legalization for individuals and society. Furthermore, almost all studies evaluating the policy effects of legalization have focused on the point in time when individual states legalized marijuana; few have focused on the policy effects of the Ogden Memo (56). Three studies that have compared pre- and post-2009 trends (in an effort to capture potential effects of the federal shift in policy) have all found measurable differences in risk perception (51), an increased number of drivers involved in motor vehicle fatalities who had positive toxicology tests for cannabis (55), and an increase in unintentional pediatric ingestions of marijuana products (57). Further research is needed to clarify the relationships among decriminalization, legalization, and prevalence.

DIVERSION OF LEGAL MARIJUANA TO MINORS

Another concern regarding adolescents and the legalization of marijuana is that of drug diversion, or that adolescents will have access to cannabis from adults with legal access to medical or recreational marijuana. In a cross-sectional survey ($n = 80$), almost half of adolescents participating in outpatient substance-abuse treatment in Colorado reported using diverted marijuana. Compared to those who had not used diverted medical marijuana, those who had were more likely to report easy availability of marijuana, >20 times of use per month in the past year, and minimal peer disapproval of regular use (58). Another study found a similarly high rate (74%) of adolescents engaged in substance-abuse treatment who reported having used diverted medical marijuana (59).

In Colorado, the legalization of marijuana and its de facto decriminalization on the federal level have led to the emergence of pediatric (nine years of age or younger) cases of unintentional ingestion of marijuana products. From 2005 to October 2009 (prior to the Ogden Memo), there were no marijuana-related emergency room (ER) visits for unintentional ingestions in Colorado. From October 2009 through 2011 (following the Ogden Memo), there were 14 pediatric unintentional ingestion ER visits that involved marijuana products, accounting for 2.4% of all ingestion visits in the state (57). An analysis of national data from 2005–2011 found a 30% annual rate of increase of such cases in states where medical marijuana was legal prior to 2005, whereas rates in nonlegal states do not seem to be changing (60).

MARIJUANA AND OPIOID USE

Another important issue in the policy debate regarding marijuana legalization is the relationship between marijuana and opioid use. Evidence suggests that marijuana and/or cannabinoids can effectively mitigate some forms of pain or discomfort. It is an empirical question whether medical marijuana would allow those prescribed opioid analgesics to taper off or at least reduce the dose of their traditional pain medications (61). To our knowledge, no clinical trial evaluating the efficacy of cannabis or cannabinoids for chronic pain has shown that cannabis use allows patients to lower their

dose of opioid analgesics. Also, cannabis use has traditionally been associated with an increased use of opioids (62). However, one recent study suggests that the passage of medical marijuana laws may be associated with a decrease over time in opioid overdose mortality compared to estimates of overdose mortality had these laws not been passed. Notably, states with medical marijuana laws have higher rates of age-adjusted opioid overdose mortality than do states without such laws (63). Further research is needed from epidemiological studies (to examine the relationship between the passage of medical marijuana laws and prevalence of opioid use) and from clinical trials (to investigate whether marijuana used to treat pain can allow patients to lower their opioid analgesic doses and maintain similar rates of analgesia).

MARIJUANA AND DRIVING

With recent changes in its legal status, the impact of marijuana on driving ability is increasingly relevant. Marijuana is the most common illicit drug reported in motor vehicle accidents (MVA) (45). However, it is difficult to ascertain a causal contribution in many of these accidents as marijuana has substantially varied effects on driving abilities due to factors such as tolerance, differences in smoking techniques, and differences in absorptions of THC (64). Evidence has shown that the potential negative effects of marijuana on driving may disappear after controlling for other risky driving behaviors (65). Epidemiological studies attempting to characterize the relationship between acute marijuana intoxication and MVA culpability have been mixed and are not as strong as the relationship between alcohol intoxication and MVAs (66).

Experimental studies indicate that acute intoxication with marijuana affects a number of cognitive and motor skills that are relevant to driving, including reaction time, attention, signal detection, information processing speed, spatial working memory, verbal learning and recall, procedural memory, tracking accuracy, time and distance estimation, set shifting, motor coordination, and danger perception (46). Results from driving simulator studies suggest that the effects of marijuana on driving may be dose dependent, with minimal to no impairment at low doses (67, 68) and progressive impairment with increasing dose (64). Also, the effects of marijuana may be more pronounced as the complexity of tasks increases (69). Notably, heavy users may exhibit minimal functional impairment in selected driving tasks (64, 70), presumably due to tolerance.

Whereas alcohol intoxication leads drivers to underestimate their impairment (resulting in speeding and other forms of increased risk taking), marijuana generally leads drivers to overestimate their impairment (resulting in slower driving speeds despite explicit instructions to maintain a particular speed). However, the combined effects on driving ability of marijuana and alcohol do not nullify each other. Evidence suggests that impairment as a result of both substances is greater than either alone (64) and may be more than additive (71).

The number of fatal cannabis-associated MVAs may be increasing. One Colorado study suggests that the number of fatal MVAs in which the driver was cannabis positive has increased with legalization, particularly with the change in federal policy in 2009; no such trend was seen in states without medical marijuana laws (55). However, given that the number of fatal MVAs has been on the decline in Colorado since 2004 (55), the perceived increase in marijuana-positive MVAs may merely reflect the general increase in cannabis use in Colorado over the study period. Further, as discussed above, the finding that a driver is marijuana positive at the time of a MVA does not indicate that marijuana was the cause of the accident (64).

ADVERSE HEALTH EFFECTS

Marijuana use is linked to several adverse health outcomes, including addiction, impaired cognition, pulmonary effects, mental illness, and other problems (45).

Addiction/Dependence

Approximately one in ten adult users of marijuana develops addiction, and this number is higher among adolescents (72). The lifetime dependence rate of marijuana is generally lower than the rates of other drugs, including alcohol, heroin, and cocaine (73). However, marijuana dependence is the most prevalent substance-abuse diagnosis, excepting alcohol and tobacco dependence (1).

Impaired Cognitive Abilities

Acute effects. Among infrequent (nondaily) users, marijuana causes impairment in the areas of attention and concentration, impulse control, planning, decision making, and working memory 0–6 h after use (46, 74). Marijuana use results in slower response time in tasks of simple reaction time, visuospatial selective attention, sustained attention, divided attention, and short-term memory, as well as impairment on a task of motor control (75). In chronic, daily users of cannabis, acute abstinence results in greater cognitive impairment than acute use. In fact, marijuana may normalize the cognitive dysfunction seen with cannabis withdrawal; however, this likely represents a lower level of cognitive function compared to that prior to onset of use (74). No significant differences were observed for critical-tracking or divided-attention task performance in a cohort of heavy, chronic cannabis smokers (76).

Persistent effects. Chronic marijuana use is associated with persistent impairment of attention, verbal memory, working memory, decision making, and executive function (46, 74). Although early evidence (using traditional neuropsychological assessments) showed that cognitive deficits associated with marijuana use resolved by day 28 of abstinence (77), more recent data show subtle, persistent cognitive deficits despite prolonged abstinence (78, 79). In support of these data is the finding of a dose-dependent effect on cognition, such that early and greater quantity of marijuana use results in greater cognitive deficits (80). This is particularly true for adolescents who begin smoking marijuana in their early teens. In one study, adolescents who began smoking cannabis early (14–22 years of age) and stopped by age 22 had significantly greater cognitive deficits at age 27 than nonusing peers (81). About 10% of cannabis-dependent adolescents report experiencing a "serious problem" with memory loss (82). In a longitudinal birth cohort comprising 1,037 individuals followed through 38 years (the Dunedin study), persistent marijuana use was associated with a six-point decline in intelligence quotient; these deficits were greater (eight points) when use began in adolescence, and, importantly, these declines did not reverse after the cessation of marijuana use (47).

Psychosis

Marijuana intoxication is associated with transient psychosis-like effects, including paranoia, ideas of reference, flight of ideas, pressured thought, disorganized thinking, persecutory or grandiose delusions, and auditory/visual hallucinations (46). Chronic daily use of marijuana has been associated with the emergence of a persistent psychotic disorder indistinguishable from schizophrenia (46), although a causal link remains controversial. The current evidence suggests that marijuana use may be a "component cause" in that it is neither necessary nor sufficient to cause schizophrenia (83). Like other negative effects of cannabis, the risk of psychosis appears to be heightened by heavy and early use (84). Large epidemiological studies have shown a dose-dependent risk for chronic psychosis as a result of marijuana exposure (83). Clearly, most people who consume marijuana do not experience psychosis; the marijuana–psychosis link may be mediated through genetic [COMT mutation (85)] and environmental [childhood maltreatment (86)] factors. With the rising potency of marijuana strains, there is some evidence that rates of first-episode psychosis

are also rising (87). Further, among persons with established psychotic disorders, marijuana use is associated with a worse course of illness (88). Chronic, daily cannabis use is also associated with the emergence of amotivational syndrome, characterized predominantly by a lack of motivation and drive (46).

Pulmonary Effects

Although marijuana smokers generally consume their cigarettes (joints) at a fraction of the quantity seen in tobacco smokers, legitimate concerns persist about the pulmonary effects of cannabis smoke, especially given that some evidence suggests higher levels of carcinogens and tars in cannabis cigarettes than in tobacco cigarettes (89). After adjusting for tobacco use and other potential confounders, some (90, 91) but not all (92) studies implicate cannabis consumption as a risk factor for lung cancer. Chronic cannabis use may lead to symptoms of bronchitis (93), although moderate marijuana use does not seem to be associated with these symptoms (94). Cannabis vaporizers are becoming increasingly popular and have been purported to decrease the amount of toxins delivered; thorough research investigating the comparative safety of marijuana smoking versus vaporization has not been done.

INTERACTIONS WITH OTHER DRUGS

In vitro studies have shown that cannabinoids can inhibit a number of hepatic enzymes that metabolize common drugs, including CYP2D6 (95), CYP2C19 (96), CYP2C9 (97), and CYP3A4 (98). Other evidence in humans suggests that marijuana may also interfere with the drug concentrations of warfarin (99) and antiretroviral therapies (100). Further research is needed to explore how components of marijuana might interact with other medications in a clinical setting.

SUMMARY

The legal status of marijuana is rapidly changing, with important implications for public health and physician practice. The evidence for the legitimate medical use of marijuana or cannabinoids is limited to a few indications, notably HIV/AIDS cachexia, nausea/vomiting related to chemotherapy, neuropathic pain, and spasticity in MS. Although cannabinoids show therapeutic promise in other areas, robust clinical evidence is still lacking. The relationship between legalization and prevalence is still unknown. States with legalized marijuana do have higher rates of use than nonlegal states, but these higher rates are generally found even prior to legalization.

As states continue to proceed with legalization for both medical and recreational use, a number of public health issues have become increasingly relevant, including the effects of acute marijuana intoxication on driving abilities, unintentional ingestion of marijuana products by children, the relationship between marijuana and opioid use, and whether there will be an increase in health problems related to marijuana use, such as dependence/addiction, psychosis, and pulmonary problems. In light of the rapidly shifting legal landscape, more research is urgently needed to better understand the impact of legalization on public health.

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