CME

Driving Under the Influence of Cannabis: A Framework for Future Policy

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Marijuana is the most widely consumed illicit substance in the United States, and an increasing number of states have legalized it for both medicinal and recreational purposes. As it becomes more readily available, there will be a concurrent rise in the number of users and, consequently, the number of motor vehicle operators driving under the influence. This article examines the cognitive and psychomotor effects of cannabis, as well as current policy concerning driving under the influence of drugs. The authors performed a MEDLINE search on the epidemiology of cannabis use, its cognitive and psychomotor effects, and policies regarding driving under the influence of drugs. Twenty-eight epidemiological studies, 16 acute cognitive and psychomotor studies, 8 chronic cognitive and psychomotor studies, and pertinent state and federal laws and policies were reviewed. These search results revealed that marijuana use is associated with significant cognitive and psychomotor effects. In addition, the legalization of marijuana varies from state to state, as do the laws pertaining to driving under the influence of drugs. Marijuana is a commonly found illicit substance in motor vehicle operators driving under the influence of drugs. Current evidence shows that blood levels of tetrahydrocannabinol do not correlate well with the level of impairment. In addition, although acute infrequent use of cannabis typically leads to cognitive and psychomotor impairment, this is not consistently the case for chronic heavy use. To establish the framework for driving under the influence of cannabis policy, we must review the current published evidence and examine existing policy at state and federal levels. (Anesth Analg 2019;128:1300–8)

Driving under the influence of drugs (DUID) is a term used to describe the use of drugs or medications that can alter one's ability to properly and safely operate a motor vehicle. Historically this included the use of illicit substances but has since been expanded to include prescription medications. Due to increasing state legislation legalizing marijuana for both medicinal and recreational use, the focus of DUID should specifically examine the effects of driving under the influence of cannabis (DUIC). At this point in time, there has been no similar push at the federal level for the legalization of marijuana, which would originate from the US Congress.

At a federal level, the Controlled Substances Act classifies marijuana, its cannabinoid components and derivatives, as Schedule I substances. Schedule I classification is defined as drugs with no currently accepted medical use and a high potential for abuse. Under federal law, physicians may only recommend medical marijuana and certify patients with qualifying medical illnesses, as opposed to writing a prescription with a route of administration, dosing regimen, and quantity. However, physicians can still prescribe synthetic cannabinoids that are US Food and Drug Administration approved in the traditional manner. Accordingly, even if doctors legally recommend some form of cannabis at the state level, they may be exposed to potential negative consequences under federal law.[1] Prosecution for marijuana-related offenses is at the discretion of the Executive Branch, especially the Department of Justice.

During the Obama administration, Deputy Attorney General James Cole distributed a memo asserting that as long as states that have legalized recreational marijuana use appropriately strict regulatory measures, they would not be subject to federal prosecution. However, should the regulations be insufficient, derelict states would potentially be subject to the enforcement of federal law.[2]

This memorandum by Deputy Attorney General Cole has since been rescinded by Attorney General Jeff Sessions. Thus, the policy of nonintervention has been replaced by one that allows US attorneys to prosecute offenders based on federal laws concerning marijuana-related activities.[3]

Marijuana is already the most commonly used illicit substance, and with the push for state legalization, its use will continue to grow. Policies for DUIC are in their nascent stages, and much work needs to be done to determine any relationships that may exist between marijuana use and driving ability.

METHODS

The literature search was conducted on the following topics: the use and abuse of marijuana, the psychomotor effects

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of both acute and chronic marijuana use, as well as current recommendations, laws, and policies. Three authors (B.M., N.P., and R.C.) performed the literature search and reviewed the results to determine which studies were included in the review. The search was limited to English-language articles and articles translated into English. Studies concerning marijuana use and abuse, DUIC, and the physiological effects of the drug were included from selected federal government databases and reports. Relevant studies concerning marijuana-related DUID were identified from a MEDLINE search of the terms "driving," "psychomotor," "cognitive," and "marijuana or tetrahydrocannabinol (THC) or cannabis." MeSH terms were determined by first conducting a preliminary search of the topic using short keyword terms, as well as browsing through the MeSH trees deemed to be essential to the subject. These terms initially produced 1257 results, of which 52 documents were selected for relevance based on our predefined selection criteria. A review and discussion of current federal and state policy and law were sourced from a review of state statutes, case law, the American Law Review, and federally funded documents from international DUID conferences.

The creation of the conceptual framework involved identifying factors related to DUIC, the outcome of motor vehicle accidents (MVAs), and the relationships between these factors and the clinical outcome of interest. The aim was to provide a working schema for future hypothesis generation. No standardized approach exists for the creation of a conceptual framework. However, corroborative evidence and expert opinion were reviewed to determine specific influences impacting DUIC. After identifying these elements, we created a diagram to depict the relationship among these various influences on DUIC (Supplemental Digital Content 1, Figure 1, http://links.lww.com/AA/C461).

RESULTS

Epidemiology of Cannabis Use and Abuse

A National Survey on Drug Use and Health in 2015 found that approximately 117.8 million people used marijuana in their lifetime, which breaks down to about 3.9 million people between 12 and 17 years of age and 113.9 million >18 years of age. Considering solely the month before when the survey was conducted, a staggering 22.2 million people used marijuana during that time.[4] A survey conducted in 2016 emphasized that marijuana is not only a problem affecting adults, showing that 23.9% of tenth graders and 35.6% of 12th graders used marijuana in the preceding year.[5]

Due to its euphoric effects mediated by binding to the cannabinoid receptor type 1 in the central nervous system, marijuana possesses significant potential for abuse. Such abuse may have potential negative societal ramifications, including during the operation of motor vehicles. In a study investigating MVA and the presence of marijuana, Brady and Li[6] found that the prevalence of cannabinol in fatal car crashes in 6 states (California, Hawaii, Illinois, New Hampshire, Rhode Island, and West Virginia) increased from 4.2% in 1999 to 12.2% in 2010.[6] However, this study did not clarify whether marijuana was the sole agent involved. Examining the findings more closely, California and Hawaii had medical marijuana legalization during the entire course of the study, Rhode Island had legalized marijuana from 2006 to 2010, while Illinois, New Hampshire, and West Virginia did not have laws legalizing medical marijuana. Therefore, this study was not able to ascertain whether state medical marijuana legalization correlated with marijuana DUIC.

A survey conducted in France revealed that cannabis was the most common illicit drug detected in fatal MVA, being present in 6.8% of crashes.[7] To gain a broader understanding of the changing prevalence of marijuana use in the United States, Shi[8] conducted a database search of hospital discharges from 1997 to 2014, which revealed a 3.5-fold increase in average hospitalization rates per 1000 discharges for marijuana dependence and abuse. Given the retrospective study design, the methodology was not sufficient to determine the effect of dosing (eg, quantity of use) and chronicity on hospitalization rates, or the relationship between marijuana use and MVA. It also remains unclear whether the rise in hospitalization rates reflected a rise in usage. However, the authors did suggest that state policy relating to legalized medical marijuana or decriminalization laws did not contribute to their findings (Supplemental Digital Content 2, Table 1, http://links.lww.com/AA/C462).

Cannabis Use and Driving Impairment

Several studies have found acute marijuana use to be associated with a ≥2-fold higher risk of crashing while driving a motor vehicle when compared to driving unimpaired.[37–42] In some cases, drivers under the influence of cannabis were more aware of their deficits and attempted to compensate by driving slower and taking less risks.[43–47] However, these behaviors do not equate to a reduced risk of accidents. The deleterious cognitive and psychomotor effects of marijuana that increase with multitasking or task complexity cannot be ignored. Studies evaluating the effects of cannabinoids on driving ability have found that participants perform worse on divided-attention tasks, during situations with decision-making dilemmas, and during long monotonous drives followed by sudden changes requiring a quick reaction.[44,45,47] The apparent detriment to driving ability as well as the correlation between acute marijuana use and MVA have been accounted for in our proposed framework (Supplemental Digital Content 1, Figure 1, http://links.lww.com/AA/C461).

Psychomotor effects related to acute cannabis use include increased lane weaving, steering wheel variability, and increased headway.[45–48] These negative effects seem to be dose-dependent, worsening with higher doses.[49–52] The majority of psychomotor effects occur in the first 2 hours and dissipate within 3–6 hours.[53] Interestingly, few or none of these acute motor effects are found to be present in chronic users.[54] Light users acutely experience decreased attention and concentration for ≤6 hours, whereas persistent users do not experience this decline.[55] Persistent users are also less affected in performance accuracy during electroencephalogram testing.[55,56] Policymakers must account for this evidence when drafting DUIC legislation to maintain an adequate level of safety on public roadways without persecuting the unimpaired. This could potentially be accomplished by standardizing the screening protocols used to detect drivers operating motor vehicles under the influence of cannabis, and emphasizing psychomotor testing, because

it is possible that similar to the argument made for chronic opioid users, minor traffic violations can occur in marijuana users that are unrelated to impairment.

The effects of chronic marijuana use on safe driving also center on cognition. These effects include impaired decision making, concept formation, and planning.[57] Cognitive side effects can persist for long periods, with both regular cannabis users and chronic nonusers exhibiting decreased inhibition, working memory, and increased impulsivity for ≤20 hours after use.[58] There are conflicting data regarding the return to one's cognitive baseline after a period of abstinence.[58–60] The study by Pope et al[59] suggests that cannabis-induced cognitive impairment is a temporary and reversible deficit, rather than an irreversible deficit that increases with duration of exposure. The study by Bolla et al[60] presented conflicting findings that instead suggest marijuana users may have persistent decision-making deficits and alterations in brain activity, with unclear evidence of a return to baseline after abstinence.

When alcohol is combined with marijuana, there is an increased risk of collision due to synergy affecting road tracking and lane weaving compared to when either alcohol or marijuana are used separately.[49,61,62]

Marijuana use impairs driving ability by disrupting normal proprioception, coordination, and reaction time in addition to reducing sustained, divided, and selective attention.[56] Notably, the degree of impairment does not necessarily correlate with one's level of intoxication because occasional users are more affected at lower plasma levels of THC and for longer durations of time.[55,56,63–65]

The psychomotor effects of combined opioid and cannabis use are not as clear. The current literature indicates that cannabis and opioid medications may act synergistically due to similarities in their intracellular signaling mechanisms.[66–68] However, no studies were found that specifically investigated the psychomotor effects of these agents when used together. Driving under the influence of opioids alone is an issue that has been addressed by individual states. Current state law concerning driving under the influence of opioids is variable and often relies on prosecutorial discretion to provide protection of the driving public and prosecution of the truly impaired. Fourteen states define "under the influence" as "incapable of driving safely," 8 states define "under the influence" using the word "impaired," and 17 states have 0 tolerance policies, whereby body fluid levels of any amount of drug capable of impairing driving performance may be grounds for sanction. However, blood levels of opioids that cause impairment in all individuals have not been determined, and implied consent for toxicology testing of motorists differs from state to state.[69] Given the parallels between the 2, it seems likely that DUIC policy will mirror several aspects of current driving under the influence of opioids policy.

There are a paucity of studies exploring the synergistic effects between benzodiazepines and cannabis, which has been emphasized in the opioid literature. Lile et al[70] conducted a small study which revealed that, although the effects of diazepam on the psychomotor changes caused by THC were limited, heart rate increased and mild sedative effects were observed (Supplemental Digital Content 3–4, Tables 2–3, http://links.lww.com/AA/C463, http://links.lww.com/AA/C464).

Current State of Marijuana Law

Traditionally, the US Food and Drug Administration is responsible for approving medications for public use; however, the widespread legalization of marijuana has come from the passing of legislation at the state as opposed to federal level. It began in 1996, when California allowed for the medical use of marijuana with the passing of Proposition 215. Since then, the legal use of medicinal marijuana has expanded to 28 other states, with 9 states legalizing marijuana for adult recreational use and 12 states decriminalizing nonmedical marijuana.[1] However, in the remaining states, marijuana possession is a misdemeanor or even a felony offense and, regardless of state law, remains illegal at a federal level. For this reason, many states that permit the use of medical marijuana prohibit patients from transporting marijuana across state lines. This lack of consistency between state and federal laws and among individual state laws is a source of confusion and possibly legal imperilment for both patients and physicians.

It is worth mentioning that the legal issues surrounding the recommending and prescribing of marijuana are not insignificant. Recommending or prescribing medical marijuana may make the prescribers liable for the driving actions of their patients under the traditional physician-patient duty of care contract. This liability may even extend to the person and property of the patient as well as third parties, as outlined in a recent review on opioids and driving.[69] During our literature search, we could find no specific example whereby a physician was held liable for a patient DUIC and having a subsequent accident. However, a review on the subject written by an attorney-physician found that case law supported the argument that physicians can be held liable by third parties when their prescribing practices fall short of standard of care and result in an injury or death to that party, including from MVA.[89]

At the federal level, the Controlled Substances Act classifies marijuana, along with its cannabinoid components and derivatives, as Schedule I substances. The Schedule I classification is reserved for drugs with no currently accepted medical use and a high potential for abuse. Under federal law, Schedule I substances may only be dispensed and possessed by a federally approved research program requiring a federal and, in many states, a state research registration. Therefore, much about marijuana's medicinal effects remains unknown due to the considerable efforts that researchers must go through to comply with state and federal regulations to perform randomized clinical trials. Under federal law, physicians may only recommend medical marijuana to patients with qualifying medical illnesses and in some states certify them with such illnesses (which may or may not be supported by strong evidence), as opposed to writing a prescription for marijuana use.

The impact of marijuana being widely available has societal implications on the general population's ability to operate motor vehicles while DUIDs.[90,91] Yet a poorly delineated boundary exists between the legal use of marijuana and the possibility of motor impairment that may result (Table 1).

Current Policy and Process for DUID

Given the increasing number of states that have passed laws for medicinal and recreational use of marijuana, health care providers should be aware of marijuana's effects on public

Table 1. State Laws Concerning Recreation and Medicinal Marijuana Usage

Law	Applicable States
No Laws Legalizing Marijuana	AL, GA, ID, IN, IA, KS, KY, MS, MO, NE, NC, OK, SC, SD, TN, TX, UT, VA, WV, WI, WY
Medical Marijuana Legalized	AZ, AR, CT, DE, FL, HI, IL, LA, MD, MI, MN, MT, NH, NJ, NM, NY, ND, OH, PA, RI
Marijuana Legalized for Recreational and Medicinal Use	AK, CA, CO, DC, ME, MA, NV, OR, VT,[a] WA

[a]Signed into law by Governor Phil Scott, effective July 1, 2018.

safety. Although it is too early to determine the long-term implications of legalizing marijuana, studies have shown an increasing trend toward DUIC in states that have marijuana laws.[13,92,93] Johnson et al[92] found that DUIC increased after legalization in California from 2007 to 2010 to 8.5% of the weekend, nighttime drivers, and in some jurisdictions, the rate was nearly 1 in 5. In Washington State, an analysis of blood toxicology results in those suspected to be driving impaired has shown an increase in the prevalence of THC and its main metabolite when comparing pre- versus postmarijuana legalization periods.[41] In these studies, marijuana detection did not appear to be an incidental finding. Johnson et al[92] found no increase in other illegal drugs, and there were few cases (n = 13) where drivers tested positive for both THC and alcohol, decreasing the probability of alcohol as a confounding factor. This increase in the number of motor vehicle operators DUIC warrants a closer look at the evaluation and screening processes used to determine the level of impairment in these drivers.

The process begins once an officer detects erratic driving or a traffic violation indicative of intoxication.[94] The officer then signals the vehicle to stop, and both parties pull over to the side of the road.[94] If the driver is suspected of DUI, then an alcohol breathalyzer test is administered to determine the blood alcohol concentration (BAC). In some instances, the BAC will not correlate with the level of impairment, increasing the suspicion of other intoxicating agents, including marijuana.[94] Currently, there is no noninvasive test to measure the level of marijuana intoxication, meaning that a blood sample needs to be tested. However, the ability of law enforcement officers to obtain a blood sample varies by location.

Depending on the state where the infraction occurs, there are different policies governing the ability of an officer to obtain a tissue or body fluid sample for testing.[91] In some states, operating a motor vehicle on public roads implies informed consent for testing, while others require a warrant to obtain samples for testing.[91]

Testing for marijuana use is based on the detection of metabolites that appear after the peak and decline of blood THC levels after marijuana is smoked. About 10% of plasma THC is metabolized via cytochrome P450 into 11-hydroxy-THC (THC-OH) and carboxy-THC (TH-COOH), a psychoactive and nonpsychoactive compound, respectively.[95] The psychoactive component peaks first and then declines rapidly, but the nonpsychoactive component can persist for several hours.

Carboxy-THC is the compound commonly screened for in urine assays.[95] The results of the urine immunoassay are confirmed by positive gas chromatography-mass spectrometry testing. The difficulty in screening for carboxy-THC is in the interpretation of the test results to determine whether a driver is impaired. The concentration of carboxy-THC in the urine does not necessarily correlate with acute impairment, especially in persistent users. This issue is further complicated by carboxy-THC being detectable in the urine for weeks despite abstinence from marijuana use and without acute impairment (Table 2).[95]

Table 2. State Laws Concerning DUID

Law	Applicable States
Implied Consent to Toxicology Testing for All Motorists	
No implied consent[a]	MA, NJ, WV
Implied consent for toxicological testing in all circumstances	All states except AL, AK, MA, NJ, WV
Permit the forced taking of a specimen over the objection of a driver[b]	AK, CA, DE, FL, HI, IL, IA, LA, ME, MD, MI, MS, NE, NV, NH, NM, NY, NC, ND, OK, PA, SC, TX, VT, VA, WA, WI, WY, DC, PR
Criminal or enhanced penalties for refusal to submit a test	AR, IN, LA, MD, MN, NE, NM, OH, RI
Arrest for refusal to submit a test	NV
Standard of Impairment Used for DUID Conviction[c]	
Zero tolerance	AZ, DE, GA, IL, IN, IA, MI, MN, NV, NC, OH, PA, RI, SD, UT, VA, WI
Under the influence	All states except NY and TX
Incapacity	AL, AR, IL, KS, MD, NV, NM, ND, OK, PA, SD, VT, WI, WY
Impairment	AZ, FL, HI, IN, KY, MT, SC, VA

Abbreviation: DUID, driving under the influence of drugs.

[a]AL and AK have no implied consent laws unless the accident involves serious injury or death.

[b]Majority limited to a crash involving serious injury or death.

[c]TX sets a standard of intoxication, which it defines as "not having the normal use of mental or physical faculties by reason of ingestion of a drug."

DISCUSSION

This conceptual framework takes into account the influence of the proposed principal domains on DUIC (Supplemental Digital Content 1, Figure 1, http://links.lww.com/AA/C461). The framework proposes 4 domains: legalization, DUIC, impaired drivers, and MVA. With regard to legalization, the number of people involved in DUIC is expected to rise with the expanding utilization of cannabis for both medicinal and recreational purposes.[1] The currently available literature reveals 3 potential groups under which marijuana users DUIC fall. The first is comprised of infrequent users, who tend to demonstrate increased blood levels of THC along with significant psychomotor impairment. The second involves chronic users who demonstrate increased blood levels of THC with slight or no impairment. Finally, chronic users demonstrate increased levels of THC with persistent psychomotor deficits. The domain of impaired drivers is a potential point of regulatory action that can be influenced by state and federal policies and laws. Finally, MVA are the preventable outcomes that can be avoided by properly imposing limitations on impaired motor vehicle operators.

At this point in time, there is no widely accepted approach to regulating drivers under the influence of

Table 3. State Laws Concerning DUIC

Applicable State(s)	Legal THC Limit
CO	Blood: 5.0 μg/L
IA	Urine THC-COOH: 50.0 μg/L
MT	Blood: 5.0 μg/L
NV	Urine THC: 10.0 μg/L Blood THC: 2.0 μg/L Urine THC-COOH: 15.0 μg/L Blood THC-COOH: 5.0 μg/L
OH	Urine THC: 10.0 μg/L Blood THC: 2.0 μg/L Urine THC-COOH: 35.0 μg/L Blood THC-COOH: 50.0 μg/L Urine THC-COOH with alcohol or drugs: 15.0 μg/L Blood THC-COOH with alcohol or drugs: 5.0 μg/L
PA	THC or THC-COOH: 1.0 μg/L in blood or urine
WA	5.0 μg/L in blood
AZ, DE, GA, IL, IN, MI, MN, NC, RI, SD, UT, VA, WI	Zero tolerance
All other states	No policy: no legally defined limit or zero tolerance policy

Abbreviations: DUIC, driving under the influence of cannabis; THC, tetrahydrocannabinol; THC-COOH, carboxy-THC.

Table 4. Conceptual Framework Utilizing the Proposed Hypotheses to Investigate DUIC

Hypothesis Source	Hypothesis
Wolff et al[99]	THC blood level of 5 μg/L if marijuana only is present and 3 μg/L threshold when detected in combination with alcohol
DRUID Project[101]	The DRUID project has suggested that a THC blood level of 3.8 μg/L is equivalent to a blood alcohol concentration of 0.05%, which is the established legal limit in several European countries
Proposed conceptual framework	
Given this variation, alcohol and THC blood tests should be used in conjunction with a psychomotor evaluation conducted by a trained specialist who is able to identify different degrees of impairment in motor vehicle operators.	

Abbreviations: DUIC, driving under the influence of cannabis; DRUID, driving under the influence of drugs; THC, tetrahydrocannabinol.

cannabis. Part of the problem stems from the inability of law enforcement officers to obtain tissue samples for testing because laws vary from state to state. In addition, there is no federal statutory limit for blood levels of THC while operating a motor vehicle, and individual states have been able to define their own limits within their own borders without consistency from state to state. Unless there are federal laws that establish implied consent, allow law enforcement officers to obtain specimens despite a motorist's objections, and standardize the approach to testing, this issue will likely remain a barrier to a coherent policy (Table 3).

Although this problem may be new to the United States, European countries have been faced with these challenges for years. Sixteen countries in Europe have set legal nonzero THC concentrations at or above which drivers are prosecuted for driving under the influence of marijuana, ranging from 0.5 to 50.0 μg/L depending on whether blood or blood serum, or THC or THC-COOH, is tested for.[96] However, 1 issue that yet again raises problems with these policies is that there is a lack of scientific consensus to support the standardization of a set of screening protocols and the establishment of a set marker for level of impairment.

This may be due in part to the lack of linear correlation between THC levels in the blood and THC levels in the brain.[97] This is further complicated by the fact that marijuana's metabolites are detectable in the blood many days after use, long after signs of impairment have disappeared.[98,99] Finally, there is considerable individual variation concerning central nervous system effects based on the chronicity of use and other factors.[100] As mentioned earlier, persistent users can have high levels of THC in the blood while displaying subtle or no impairment.[55,56] Given the equivocal evidence correlating specific blood levels of THC with psychomotor impairment, there may not be a place for a standardized federal limit of THC to indicate impairment. As noted previously, emphasis should be placed on psychomotor tests to detect impairment, using blood or saliva testing only as a supplementary component to establish presence.

The DRUID project and an expert panel on drug-impaired driving reviewed the available evidence to develop recommendations on thresholds for blood THC levels. The DRUID project, based on roadside surveys, has suggested that a THC blood level of 3.8 μg/L is equivalent to a BAC of 0.05%, which is the established legal limit in several European countries (in the United States. Utah has passed legislation lowering the legal BAC limit from 0.08% to 0.05% as of the end of 2018).[101] Wolff et al[99] have taken a different approach and recommended 2 different thresholds: a THC blood level of 5 μg/L if marijuana is the sole agent present and a lower 3 μg/L threshold when marijuana is detected in combination with alcohol.

Given this variation and the proposed conceptual framework, our hypothesis is that alcohol and THC blood tests can be used in conjunction with a psychomotor evaluation conducted by a trained specialist who is able to identify varying degrees of impairment in motor vehicle operators. With combinations of substances, it is more important to verify any impairment as opposed to impairment due to a specific causative agent, which may not be possible. Testing general psychomotor performance in a standardized method would be ideal, leveraging techniques from current existing sobriety tests (Table 4).

Rather than establishing a legal limit for THC in the blood, the standardization of psychomotor screening protocols can help to set the framework for DUIC policy (Table 5).

The Opioid Risk Tool, Screener and Opioid Assessment for Patients with Pain, and Current Opioid Misuse Measurement are among several assessment tools created for the purpose of assessing risk for individuals who are prescribed opioids for the treatment of chronic pain.[102–104] These screening assessments are often used in the office by primary care and pain physicians before prescribing opioids. This process helps to identify patients who may be at risk for aberrant medication-related behavior. Using these assessment tools, providers can make a determination as to the appropriateness of long-term opioid treatment. If opioids are deemed a potential treatment option for a patient, additional resources can be allotted for the monitoring and

Table 5. Recommendations for Screening for DUIC

DUIC Screening Method	Implementation
Prescription verification	Utilize local prescription drug monitoring program
Legal	Verify federal versus state law and jurisdiction
Surveillance	Obtain witness accounts, video recording of the event in question
Laboratory assessment	Measure blood levels of THC: THC blood level of <5 μg/L if marijuana is the sole agent, <3 μg/L if alcohol is present
Physical assessment	Administer a field sobriety test, preferably by a Drug Recognition Expert
Cognitive assessment	Test working memory, power of attention, and continuity of attention

These screening tools should be used together to determine sobriety.
Abbreviations: DUIC, driving under the influence of cannabis; THC, tetrahydrocannabinol.

Table 6. Recommendations for Screening for Prescribing Cannabis

Cannabis Screening Tool	Practical Application
Prescription verification	Utilize local prescription drug monitoring program
Determine level of risk	Administer Opioid Risk Tool[102] or similar validated instrument to extrapolate for nonopioid substance abuse
Laboratory assessment	Administer oral swab or urine drug screen

If the urine drug screen is consistent with the local prescription drug monitoring program and the patient is deemed to be low risk, one can consider prescribing medical marijuana. If the patient is on opioids, a reduction in opioid dose should be considered, especially if the marijuana will be prescribed for pain.

management of that patient. This includes frequent random urine drug screens, short-term prescriptions, close follow-up, and designation of a proxy.

Although these tools stratify risk for abuse in general and may be adaptable for cannabis use, they have not been validated in this context. There are several important differences between medicinal marijuana and opioids, including legality, consequences of abuse, and the fact that physicians do not actually prescribe medical marijuana and follow patients to assess the risk:benefit ratio but instead write a letter of recommendation certifying that a patient has a medical condition that qualifies for medicinal marijuana use. Given the inherent risks of cannabis, the lack of medical oversight is inconsistent with the regulations governing the dispensation of analgesic medications with greater safety profiles such as adjuvants, muscle relaxants, and nonsteroidal anti-inflammatory drugs. The lack of consistent follow-up after initiation of treatment will also limit the generation of data regarding effectiveness in large-scale populations and inevitably result in some patients continuing and escalating use despite ineffectiveness and an unfavorable risk:benefit ratio.

The domain of DUIC within the proposed conceptual framework includes the acute effects of marijuana as well as potentially other substances. This is due to the fact that marijuana will likely be prescribed for patients with several different concurrent diseases, who will continue to experience pain even with treatment.[105] When one considers that even first-line medications only modestly alleviate pain in a small percentage of patients, it is likely that most medicinal marijuana users will utilize other medications that can depress the nervous system, with 1 study finding that more than two-thirds of chronic patients were taking multiple prescriptions that carry additive effects, often from several drug categories.[106]

For those receiving opioids, these cumulative risks are substantial. Between 6.2% and 39% of medicinal marijuana users also consume prescription opioids, which could lead to adverse additive or synergistic effects, although the required close supervision of chronic opioid users would hopefully mitigate some of the risks.[107,108] Health care providers who prescribe medicinal marijuana often decrease the amount of opioids prescribed concurrently. A time-series analysis of medical marijuana laws in the United States from 1999 to 2010 showed that states with medical cannabis laws had a lower mean opioid overdose mortality rate compared to states without medical cannabis laws.[109] Therefore, the authors of this article advise similar precautions for prospective marijuana prescribers (Table 6).

As marijuana use continues to grow and establish a firm foothold in modern society, it is imperative that an infrastructure be created to help guide future laws and policies. Utilizing the principle domains of the legalization of marijuana, DUIC, driver impairment, and MVA, we hope to assist in establishing such a conceptual framework.

DISCLOSURES

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