

Medical Marijuana in the Workplace

Challenges and Management Options for Occupational Physicians

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Although possession and use of marijuana is prohibited by federal law, legalization in four states (Alaska, Colorado, Oregon, and Washington) and allowance for palliation and therapy in 19 others may reposition the drug away from the fringes of society. This evolving legal environment, and growing scientific evidence of its effectiveness for select health conditions, requires assessment of the safety and appropriateness of marijuana within the American workforce. Although studies have suggested that marijuana may be used with reasonable safety in some controlled environments, there are potential consequences to its use that necessitate employer scrutiny and concern. Several drug characteristics must be considered, including Δ^9 -tetrahydrocannabinol (Δ^9 -THC, or THC) concentration, route of administration, dose and frequency, and pharmacokinetics, as well as the risks inherent to particular workplace environments.

The U.S. Substance Abuse and Mental Health Services Administration estimated in 2007 that 8.4% of full-time workers had engaged in some type of illicit drug use within the preceding month.¹ Studies conducted to evaluate illicit drug use by workers have demonstrated variable risk. This inconsistency is related to study design, demographics, work type, and potential confounders (such as general risk-taking behavior among illicit drug users). There is, however, a likely statistical association between illicit drug use (including marijuana) and workplace accidents.² The Occupational Safety and Health Administration (OSHA) has traditionally taken a protective stance against drug impairment in the workplace. In a 1998 letter of interpretation, the Director of Enforcement Programs responded, "OSHA strongly supports measures that contribute to a drug-free environment and reasonable programs of drug testing within a comprehensive workplace program for certain workplace environments, such as those involving safety-sensitive duties like operating machinery. Such programs, however, need to also take into consideration employee rights to privacy. Although there are no regulations specific to the topic, protection from drug impairment is covered under the general duty clause."³

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Within the context of illicit drug use, the effect of cannabis use among workers has been a topic of increasing discussion in occupational medicine. This interest relates to the emergence of fresh science, and even more to the changing legal landscape. The importance may grow further as the continued reform of state medicinal and recreational marijuana laws enables a higher prevalence of marijuana use. As of December 2013, the state of Colorado had 112,862 registered users of medical marijuana.⁴ California had issued a total of 71,144 registration cards for illness treatment and palliation.⁵

In addition to risk of injury, industry must also consider the possibility that increases in absenteeism and presenteeism may occur, as marijuana-containing products become increasingly available to workers. At present there is inadequate research to draw clear conclusions on the relationship between off-shift marijuana use and workplace safety and productivity. There may be limited situations where a low Δ^9 -tetrahydrocannabinol (Δ^9 -THC or THC) concentration, or minimal residual THC bioavailability, in the context of low-risk activity, does not pose measurable hazard or productivity loss. At the same time, occupational physicians must be alert to the potential for devastating consequences of marijuana-related impairment. This risk was highlighted in 2013 by the allegation that illicit marijuana use was a key contributing factor in a heavy machinery accident that took the lives of six individuals.⁶ Workers in federal drug-testing programs are uniformly prohibited from using marijuana at any time. Furthermore, under federal law employers in every state may prohibit employees from working while under the influence of marijuana and may discipline employees who violate the prohibition. In some states, however, "under the influence" is more narrowly construed for marijuana use than it is for other controlled substances.⁷

This report summarizes the history of medical marijuana use, known and potential health effects of the drug, dosing and delivery systems, psychomotor effects, and pharmacokinetics. It specifically seeks to help employers decide whether there are circumstances under which medical marijuana might be used with reasonable safety by workers. Specifically, the review attempts to answer the following questions:

1. Is it appropriate for employers to ban marijuana use at home or work, even in states where the drug is legal for medicinal or recreational use?
2. Can dose and concentration of THC, route of administration, serum THC levels, or washout period reliably predict impairment?
3. For employers who choose to tolerate use of medical marijuana by workers between shifts, are the standards for assessment of impairment currently used for other psychoactive medications consistently reliable?
4. Are there special clinical considerations necessary to assess the safety of medical marijuana use among workers?

The review is specific to cannabis and cannabis-derived products. It does not cover the use of dronabinol (Marinol[®]), nabilone (Cesamet[®]), purified cannabidiol (Epidolex[®]), products approved

outside of the United States (Sativex®), or illicit synthetic cannabinoids. (In the text to follow, the term “cannabis” refers to marijuana leaf and its derivatives.) It is beyond the scope of this report to address whether marijuana has been adequately proven to be safe and effective palliation or treatment of specific human diseases. It does not provide clinical recommendations (such as therapeutic dosing or administration route). Finally, the report does not address the provision or exclusion of employer-subsidized health benefits for the purchase of marijuana for medical use.

HISTORY OF CANNABIS AS THERAPY

The first recorded cannabis use dates to 2737 BC, by the emperor Shen Neng of China. Historically, marijuana tea was recommended for the treatment of gout, rheumatism, malaria and, poor memory.⁸ The introduction of medicinal cannabis in America is attributed to Dr W. B. O’Shaughnessy, who in the mid-nineteenth century, published case reports suggesting utility for relief of rheumatism, tetanus, and infantile convulsions.⁹ In 1850, cannabis was included in the *United States Pharmacopeia*, where it remained until 1941.¹⁰ By the late 1900s, American medical journals published recommendations for the use of hemp seeds and roots for the treatment of inflamed skin, incontinence, venereal disease, chorea, epilepsy, anorexia nervosa, uterine atony, migraines, depression, and a broad range of other ailments.^{11–13}

During the twentieth century, medical uses of cannabinoids became better documented and more refined, particularly for the treatment of elevated intraocular pressure and cancer-related anorexia-cachexia.¹⁴ At its peak in the 1930s, there were at least 2000 cannabis medicines worldwide, with more than 280 manufacturers. Starting in the 1980s, the importance of this class surged, with discovery of the human cannabinoid neurotransmitter system.¹⁵ Cannabinoids are critical for normal human physiology, specifically in the control of movement, pain, appetite, memory, immunity, and inflammation.¹⁶

Despite a growing body of evidence that cannabinoids are medicinally useful, the emergence of a restrictive legal environment stunted both research and application during the twentieth century, ultimately resulting in the withdrawal of support for its use in the care for human disease. As required under the Comprehensive Drug Abuse Prevention and Control Act of 1970, all forms of natural cannabinoids are currently classified as schedule I substances.¹⁷ In response to efforts to reclassify marijuana in 2011, Drug Enforcement Administrator Michele M. Leonhart said she rejected the request because marijuana, “has a high potential for abuse,” “has no currently accepted medical use in treatment in the United States,” and “lacks accepted safety for use under medical supervision.”¹⁸ This federal certainty is not, however, uniformly shared at the state level, or by consensus within the medical community.

LEGAL HISTORY OF CANNABIS IN THE UNITED STATES

Even while marijuana was gaining support for medicinal use in the nineteenth century, a backlash was forming within various levels of government. Early restrictions were crafted into state and local “poison acts” that were precursors to more standardized legislation. These statutes, generally designed to stem the proliferation of unsafe patent medicines, had variable effects on the sale of cannabis compounds. By the turn of the century, state legislative momentum against marijuana use was increasing, through suggestions that the drug shared the addictive and antisocial properties of opium. In 1907, California became the first state to outlaw marijuana as a poison. Similar legislation was passed in other states during succeeding years.¹⁹

The Pure Food and Drug Act of 1905, though not specific for cannabis-containing preparations, restricted the sale of many compounds and imposed standardized labeling requirements. The

Marijuana Tax Act of 1937 added a \$1 levy on the sale or transfer of marijuana, and further discouraged its use through a complex series of reporting requirements and stiff penalties for nonadherence.²⁰ The act was approved by Congress despite intense lobbying by the American Medical Association, which recognized the stipulations as effectively ending the use of cannabis for the treatment of disease. The Tax Act remained as the predominant federal law until 1969, when it was invalidated by the US Supreme Court on the basis of incompatibility with the fifth amendment of the US Constitution.²¹ The following year, the Act was officially repealed as part of the Comprehensive Drug Abuse Prevention and Control Act.²² That federal law still makes marijuana possession, distribution, or manufacture illegal for any purpose other than research. Physicians are prohibited from recommending or prescribing cannabis-containing medications. Furthermore, the US Supreme Court has ruled that the federal government can arrest state-recognized medical cannabis patients.²³ The legal implications of the continuing ban extend to the Americans with Disabilities Act. For example, in 2012 the U.S. Ninth Circuit Court of Appeals ruled that denial of medical marijuana use—which resulted from the City of Costa Mesa closing dispensaries to enforce a city ordinance that prohibited the sale of medical marijuana—does not constitute a violation of Title II of the Americans with Disabilities Act, by virtue of the federal prohibition.²⁴

The federal stance was further solidified by passage of the 1988 Drug-Free Workplace Act. This law stipulated that *some* federal contractors and *all* federal grantees agree to provide drug-free workplaces as a condition of receiving a contract or grant from a federal agency. The Act contains detailed requirements for organizations and businesses that promote development of comprehensive drug use prevention programs.²⁵

CURRENT STATE LEGAL STATUS AND MEDICINAL USES OF CANNABIS IN THE UNITED STATES

Reversal of state prohibitions began with California’s Compassionate Use Act of 1996. The Act was designed to ensure that “seriously ill” residents have access to marijuana for medical purposes to relieve suffering. The Act exempts clinicians, patients, and primary caregivers from criminal prosecution for possessing or cultivating marijuana for medicinal purposes when approved by a physician. Notably, the act states that physicians “shall not be punished, or denied any right or privilege, for having recommended marijuana to a patient for medical purposes.”²⁶ Following California’s lead, other states have legalized the use of cannabis as approved by a physician. Tension between state approval and federal prohibition is most clearly manifested in the antidiscrimination provisions within several statutes. For example, Arizona’s law states, “Unless a failure to do so would cause an employer to lose a monetary or licensing related benefit under federal law or laws, an employer may not discriminate against a person in hiring, termination or imposing any term or condition of employment or otherwise penalize a person based upon either:

1. The person’s status as a cardholder.
2. A registered qualifying patient’s positive drug test for marijuana components or metabolites, unless the patient used, possessed or was impaired by marijuana on the premises of the place of employment or during the hours of employment.²⁷

Several other states, including Connecticut, Delaware, Illinois, Maine, Minnesota, Montana, and Rhode Island, have enacted laws that provide restrictions on an employer’s ability to discriminate against a medical marijuana patient. It is significant that the various state-approved indications for marijuana use are uniformly broader and generally less well defined than the Food and Drug Administration (FDA)-approved indications for dronabinol.²⁸ At

present, medical marijuana is permitted for the following indications:¹⁸

- Cancer—16 states
- HIV-AIDS—16 states
- Epilepsy—16 states
- Glaucoma—15 states
- Cachexia or wasting syndrome—14 states
- Severe nausea—13 states
- Severe or chronic pain—12 states
- Severe muscle spasms—11 states
- Multiple sclerosis—6 states
- Inflammatory bowel disease—5 states
- Amyotrophic lateral sclerosis—3 states
- Spinal cord damage with spasticity—3 states
- Alzheimer disease—3 states
- Hepatitis C—3 states
- Intractable spasticity—2 states
- Anorexia—2 states
- Appetite loss—2 states
- Any terminal illness or admission to hospice—2 states
- Parkinson disease—2 states
- Huntington disease—1 state
- Nail-patella syndrome—1 state
- Cramping—1 state
- Parkinson disease—2 states
- Arthritis—1 state
- Migraine—1 state
- Muscular dystrophy—1 state
- Posttraumatic stress disorder—1 state
- Neuropathies—1 state
- Any chronic or persistent medical condition—1 state
- Any other medical condition approved by state legal agency—12 states

Contrary to the rationale for prevailing federal restrictions, considerable published medical opinion holds that marijuana has value in the treatment or palliation of human disease.²⁹ An Institute of Medicine Report on marijuana and medicine, published in 1999, concluded, “Scientific data indicate the potential therapeutic value of cannabinoid drugs, primarily THC, for pain relief, control of nausea and vomiting, and appetite stimulation; smoked marijuana, however, is a crude THC delivery system that also delivers harmful substances.”³⁰ In an extensive review of published literature, Yadav and colleagues³¹ found that oral or oromucosal cannabis is effective for multiple sclerosis-related pain and spasticity. Of note in their review was the uncertainty of the safety or efficacy of smoked cannabis in the palliation of multiple sclerosis symptoms. Perhaps the best way to outline the potential therapeutic effects of medical marijuana is to refer to the indications listed above for use in states where physician-recommended use has been legalized.³²

Occupational physicians and the companies they support should be aware that the legal landscape surrounding medical marijuana is almost constantly changing. As such, it is essential to review both federal and state laws, as well as relevant case law, before forming policy. In addition, existing policy should be reviewed on a regular basis to ensure consistent legal compliance.

FORMS OF CANNABIS AND POTENCY

Although *Cannabis indica* was often used before the twentieth century, the majority of marijuana currently cultivated or imported into the United States is *Cannabis sativa*. There are more than 400 different chemical compounds found in the *C. sativa* plant including over 60 cannabinoids.³³ Cannabinoids modulate neurotransmission through receptors in the brain (CB₁) and gut and immune system (CB₂).³⁴ Δ⁹-THC, which is active at CB₁ receptors, is primarily responsible for the plant’s psychoactivity.³⁵ Marijuana plants contain

variable concentrations of active ingredients, which are related to the seed stock and growing conditions. Over the last few decades, growers have been selecting more potent strains with higher concentrations of THC. A study published in 2000 in the *Journal of Forensic Sciences* found that the average THC content of cannabis available for purchase “on the street” in the United States ranged from approximately 3.3% in 1983 and 1984, to 4.47% in 1997.³⁶ More recent research found that average THC levels in US-purchased cannabis increased from 4% in 1983 to 9.6% in 2007.³⁷ Concentrations in the 15% to 20% range are reported in the Netherlands.³⁸ At the same time, there is recognition of the therapeutic value of low or zero THC strains that rely on cannabidiol or other non-THC cannabinoids for effect. In one study of nabiximols (Sativex[®]), a fixed 1:1 THC/cannabidiol extract, available for limited indications (primarily multiple sclerosis-induced spasticity) in several European countries and Canada, intoxication scores were low and only 2.2% of users reported euphoria.³⁹ Low THC strains may be preferred by patients with chronic pain, for example, who do not want the psychoactive effect. The physiologic impact of this variability is further complicated by differences in route of administration and smoking efficiency. In some individuals, the escape of sidestream smoke is as high as 40%.⁴⁰ In addition to smoking, cannabis may be administered by vaporization, ingestion, or skin absorption. Each route is associated with distinct bioavailability and metabolic characteristics.

PHARMACOKINETICS OF THC

Cannabinoid pharmacokinetics encompass absorption from diverse routes of administration and from different drug formulations, metabolism by both the liver and extrahepatic tissues, and elimination in the feces, urine, sweat, oral fluid, and hair. These processes are affected by the duration and frequency of use and the magnitude of drug exposure.⁴¹ Although there are multiple metabolic and elimination pathways, the major route of cannabinoid breakdown is via liver microsomal metabolism. Genetic polymorphisms exist and several cytochrome P450 isoforms contribute to metabolism. CYP3A4 and CYP2C19 seem to be the most important catalysts.⁴²

Currently in the United States, cannabis products are most commonly inhaled or consumed orally. Pulmonary absorption of inhaled smoke or vaporized THC causes a maximum plasma concentration within minutes. Bioavailability following the smoking route has been reported between 2% and 56%. This large range is largely due to variability in smoking dynamics related to the following: the number, duration, and spacing of puffs; the hold time, and the inhalation volume.⁴³ Directly observable psychotropic effects start within seconds to a few minutes, reach a maximum after 15 to 30 minutes, and begin to taper off within 2 to 3 hours.

In states that allow medical marijuana, oral preparations are sold as baked goods, candies, oil emulsions, and tablets. Although the psychoactive effects are comparable, when cannabinoids are ingested orally there is a lower and longer-delayed peak THC concentration.⁴⁴ This is because THC is absorbed from the gastrointestinal tract more slowly than through the lungs and continues to be absorbed for a longer period. After oral ingestion, directly observable psychotropic effects begin after 30 to 90 minutes, reach their maximum at 2 to 3 hours, and remain apparent for 4 to 12 hours, depending on dose and specific effect.⁴⁵ There is first-pass elimination through the liver that does not occur with smoking.

Wall and colleagues⁴⁶ reported a net bioavailability of 10% to 20% after consumption of THC. The dose, carrier vehicle (generally a fat-containing food such as ice cream, brownie, or oil concentrate), and physiologic factors such as absorption efficiency from the gastrointestinal tract and rates of metabolism and excretion influence bioavailable drug concentrations. These factors are unique to each individual and difficult to predict. Perez-Reyes et al⁴⁷ described the efficacy of five different vehicles for oral administration of THC in gelatin capsules. Glycocholate and sesame oil improved the

bioavailability of oral THC; however, there was considerable variability in peak concentrations and rates of absorption, even when the drug was administered in the same vehicle.

Research suggests that transdermal application of cannabinoids, either as an emulsion or formed onto a patch, is an attractive alternate delivery system. Similar to inhalation, the transdermal route eliminates first-pass hepatic metabolism. Slow-release transdermal formulations may improve dosing regimens and reduce the potential for abuse. Skin application also resolves the issue of pulmonary irritation and associated adverse reactions. The utility of this route is challenged, however, by the compounds with relative hydrophobicity, making transport across the aqueous skin layer rate and dose-limiting. Once absorbed, mean steady-state plasma concentrations of THC are achieved within 1.4 hours (compared with approximately 17 hours for fentanyl patches) and maintained for at least 48 hours.⁴⁸

Vaporization provides yet another option for THC delivery. By heating cannabis to 180°C to 200°C, cannabinoid resins may be vaporized, while avoiding the higher temperature combustion of other plant components, such as benzene, toluene, naphthalene, and CO. This form of administration is as efficient as smoking, bypasses the liver, and may decrease the risk of toxicity related to marijuana smoke inhalation.⁴⁹

Sativex[®] is intended for oromucosal administration. Studies have shown that the bioavailability of this route is statistically similar to ingested preparations of comparable drug, although it is not subject to first-pass metabolism.⁵⁰ This preparation is currently under phase III trial for cancer-related pain, in anticipation of possible FDA consideration.⁵¹

HEALTH RISKS ASSOCIATED WITH MARIJUANA USE

Smoking marijuana may not be without health risks. Hundreds of distinct components can be isolated from the leaves of *C. sativa*. Smoking marijuana, regardless of the THC content, results in a substantially greater respiratory burden of carbon monoxide and tar than smoking a similar quantity of tobacco. This may relate to the composition of cannabis smoke as well as differences in inhalation technique.⁵² Despite the concentration of known human carcinogens, pure marijuana smoke does not seem to be overtly carcinogenic in humans. THC does not cause malignant lesions in skin tests on rodents, although cannabis smoke may induce tumors. Several researchers have investigated the possible correlation between marijuana smoking and squamous cell cancers of the head and neck in humans. This line of study has led to conflicting results, but does not demonstrate clear carcinogenicity when controlled for alcohol and tobacco use.⁵³ There are case reports of both myocardial infarction and stroke associated with the use of marijuana, but these are small in number and may be related simply to the prevalence of marijuana use, or to the orthostatic hypotension that has been observed in marijuana naive older subjects using potent THC-containing marijuana. There exists only the lowest level of scientific evidence linking the use of marijuana to end organ damage despite the millions of people in the United States who use the drug regularly. Marijuana may exacerbate asthma, induce panic attacks in individuals who have never experienced significant anxiety in the past, and may cause overeating. Prenatal marijuana use is associated with fetal growth reduction, a negative impact of school achievement, and is teratogenic on the developing brain. It should not, therefore, be used by pregnant women. The lifetime risk of addiction is estimated to be 9% compared with 32% for tobacco and 15% for alcohol.⁵⁴ There does not seem to be any harmful effects to the lungs of marijuana users.⁵⁵ Although there is no data quantifying the risk to health, the safety of marijuana smoke may also be affected by contaminants, including microbes (such as molds, *Escherichia coli*, and salmonella), pesticides, and residual solvents (such as butane used in hashish processing).

CANNABIS USE AND IMPAIRMENT OF JUDGMENT AND PSYCHOMOTOR SKILLS

Numerous studies on the cognitive and psychomotor effects of cannabis have been conducted over recent decades. A recent review summarized contemporary research on the topic. It highlighted the negative effect of cannabis on learning and memory, in addition to deficits in attention, concentration, and abstract reasoning.⁵⁶ Development of scientific consensus has been hampered by multiple confounding variables including testing scenario, dose, and duration of marijuana use by test subjects. Some studies have concluded that acute marijuana use does not significantly attenuate cognitive performance in experienced users, although a greater number have demonstrated diminution or delay in cortical processing.⁵⁷ Although definitive conclusions about the acute and lingering effects of the drug have been elusive, there is now a large body of evidence to support the persistence of neurocognitive impairment lasting from hours to weeks. It is important to note that in repeated studies, subjects who reported a marijuana “high” were most likely or most profoundly affected by the drug. This supports the link between THC concentration and neurocognitive dysfunction. Residual effects, however, continued in subjects who no longer felt the drug’s effect. Thus, subjective return to baseline mental status may not ensure full return of neurocognitive function.⁵⁸

Considerable research into the functional psychomotor and judgment effects of marijuana smoking has been conducted in the context of transportation safety. Research demonstrates that acute cannabis consumption is associated with an increased risk of a motor vehicle crash, and especially for fatal collisions.⁵⁹ Although the significance of driving effects is certainly individual and dose-dependent, there is consensus that use is often associated with impairments of lane tracking and braking reaction time. Intoxication was also generally associated with inattention to speed and aversion to risk taking. In one study, subjects under the influence of marijuana were considerably less likely to pass a slow-moving vehicle in their lane.⁶⁰ There has been some testing in the airline industry that correlates with driving impairment. In one simulator study, the number of aileron, elevator, and throttle changes, the magnitude of control changes, variation from the center of the runway on landing, and lateral and vertical deviation from an ideal glideslope and center line over the final mile of the landing approach were all impaired at 1, 4, and 24 hours after consumption of marijuana.⁶¹

The findings on transportation safety have been generalized through other lines of research. These include tests demonstrating that, at very high dose, the drug causes persistent, negative effects on verbal and visual memory, executive functioning, visuoperception, psychomotor speed, and manual dexterity. This level of use was shown to be associated with decrements in neurocognitive performance even after 28 days of abstinence. This persistence is generally linked to very heavy use of the drug.⁶² Although other reports suggest that neurocognitive and withdrawal effects do not extend beyond 25 days, performance and safety could conceivably be compromised even after a several-week period of abstinence.⁶³ Although available research is not yet sufficiently nuanced, it may be possible in the future to separate acute from nonacute manifestations of marijuana use.

Heishman et al⁶⁴ conducted a study to explore lingering effects of marijuana smoking. In their experiment, three subjects participated in experimental sessions in which they smoked zero, one, or two marijuana cigarettes containing 2.57% THC at two different times on a single day. Physiologic, subjective, and performance measures were repeated throughout the consumption day to assess acute effects, and on the following day to measure residual effects of marijuana intoxication. Performance was impaired on a circular lights task, serial addition/subtraction, and digit recall tasks on day 1. On day 2, performance remained impaired on the arithmetic and recall tasks, although to a lesser extent than the previous

day. Although the study was limited by inclusion of only three subjects, these preliminary results suggest that marijuana may adversely affect complex human performance up to 24 hours after smoking.⁶⁴

It is significant to note that many, if not most, studies on the functional effects of marijuana have been performed on subjects exposed to low-potency (\pm 4% THC) strains that are less likely to be currently available. Higher-potency (19%) marijuana has been demonstrated to consistently impair executive function and motor control for periods in excess of 6 hours after cessation of smoking.⁶⁵ It is reasonable to presume that emerging high-potency THC strains will have proportionally greater and more prolonged psychomotor effects.

In states where marijuana is available for medicinal use, some products are marketed as being nonsedating and nonimpairing, with some cannabis dispensaries promoting certain strains as being safe for use during work hours. These claims generally stem from the relative proportion of THC to cannabidiol. The distinctions are mostly anecdotal, and have not been scientifically substantiated.⁶⁶ It is reasonable, however, to anticipate the identification and cultivation of marijuana strains that are optimized for activation of either CB₁ or CB₂ receptors. Early research has also raised the possibility that selective inhibition of CB₁ receptors might improve the safety profile of cannabinoids. Although pregnenolone has demonstrated reduction in cannabinoid-induced behavioral and neurobiologic effects in rats, this line of research has not yet extended into human trials.⁶⁷

Studies have suggested that a psychoactive tolerance develops with chronic marijuana use, and that impairment among acute- or short-term users is significantly greater than for long-term smokers. A double-blind study performed by Hart and colleagues⁶⁸ showed that acute marijuana smoking produced minimal effects on complex cognitive task performance in experienced users. It is not clear, however, whether the development of tolerance may be factored into a safety equation among marijuana users. Studies have linked marijuana use directly with an increased prevalence of workplace injury. Normand and Salyards,⁶⁹ for example, found that postal workers who tested positive for marijuana on a preemployment urine drug test had 55% more industrial accidents, 85% more injuries, and a 75% higher absenteeism rate, compared with those who tested negative.

SAFEGUARDS FOR MEDICAL MARIJUANA USE AMONG WORKERS

Given the variables inherent in the use and effects of marijuana, it may be impossible to ensure safety among workers. The authors recognize that prohibition of marijuana use by employees and contract workers while on duty or subject to duty is a safe and responsible standard. Total prohibition of medical marijuana use would not likely leave an employer exposed to claims under federal laws, including the Americans with Disabilities Act. Although laws in several states prohibit discrimination based on the use of marijuana, a 2013 case litigated in federal court ruled against an employee in Colorado who claimed he was fired for testing positive for marijuana use outside the workplace.⁷⁰ This ruling was, however, considerate of Colorado law that specifically states employers need not “accommodate the medical use of marijuana in any work place.”⁷¹ The outcome cannot be generalized to other states where broader use is allowed. Employers should not presume that discipline against employees failing a drug test for marijuana is compliant in all states or under all circumstances.

Employers who choose to approve or tolerate medical marijuana based on their interpretation of state laws or for moral or

ethical reasons should clearly define the responsibilities of the employer, supervisor, human resources manager, employee, and treating physician. Companies may consider creating a policy specific to the issue. The policy should clearly state the conditions (both personal and job-related) under which marijuana tolerance would be considered. Although not intended for this purpose, a company’s medical workplace accommodation policy might be adapted to document the need and parameters for use outside the workplace. This would provide a mechanism for physician documentation of approved medical condition, rationale for necessity of the drug, dosing information, route of administration, and estimated treatment duration. Workers should be required to report updates to any of these parameters, or whether their pattern of use has changed. A contract similar to the frequently deployed opioid use agreement could also be helpful. This document can help assure that workers understand the potential harms that may result from marijuana use and consent to adhere to the company’s tolerance policy.

It is reasonable to consider neurocognitive testing of workers using marijuana, so long as limitations are understood. Foremost is the lack of standardized testing for THC impairment. Several test panels have been used in the research setting. These are generally not of clinical value, however, and have not been standardized for the workplace. Some, such as the Mini Mental State Evaluation, lack the sensitivity for consistent detection of subtle impairment. Others, such as the Assessment Battery-Screening Module and Adult Reading Test and the Assessment Battery-Screening Module, are too cumbersome for occupational use.

Accepted clinical panels such as the Cambridge Neuropsychological Test Automated Battery (CANTAB, Cambridge Cognition, Oak Brook, Illinois) or the Montreal Cognitive Assessment may be useful, especially if a pretreatment baseline is established.⁷¹ Clinicians must be aware of the limitations of any specific test, especially in the context of job requirements. For example, impairment in worker motor skills may not be detected by standard neurocognitive batteries. Determination of neurocognitive performance during treatment with marijuana must be invalidated when any of the common variables, such as timing of use, delivery system, or strain of marijuana, changes. As such, workers should be informed that tolerance of marijuana use is entirely contingent on consistency of product, amount used, frequency, and route of administration. Changes to any of these variables would require retesting before continued use may be approved.

Although workers using marijuana in any form will challenge occupational clinicians with multiple, complex impairment variables, ingested THC may be more difficult to manage than inhaled forms. From 10 to 30 mg of THC is recommended for intoxication, although this dose is dependent on multiple variables. The rapid onset of inhaled drug provides some allowance for titration to therapeutic neurocognitive effects. The slower onset of ingested forms is more likely to trigger an “all or none” approach that may result in either a subtherapeutic level or excessive impairment. Although marijuana edibles may be labeled with THC content, the stated value does not often correlate with laboratory-confirmed measurements. In one independent assessment, the THC content in seven of the 12 edible samples varied from the package labeling by more than 40%.⁷² Finally, the unit dosing (generally, one piece) of edible marijuana may be difficult to divide into an accurate ideal dose. For example, a 100-mg cookie may not be divisible into 10-mg doses. Candies and other hardened edibles may not be divisible at all.⁷³

THC AND THE MEDICAL REVIEW OFFICER AND PER SE DRIVING LAWS

If a company is drug testing under their own substance abuse policy (and is not subject to federal drug-testing laws) in those states where authorized by law, it is imperative that their policy addresses the use of marijuana. If an individual is being tested under federal

*The court explained that “[d]espite concern for [the plaintiff’s] medical condition, anti-discrimination law does not extend so far as to shield a disabled employee from the implementation of his employer’s standard policies against employee misconduct.”

authority (eg, DHHS, DOT, and NRC), use of marijuana or its components *must* be consistent with federal law and therefore medical or recreational cannabis would not be accepted as a valid explanation under federal drug testing. When considering a uniform company policy on the use of marijuana, it is more challenging, especially for those companies with operations in multiple states, some of which may have legalized marijuana for recreational or medicinal purposes. Many will follow the federal law that prohibits the use of marijuana.

Relying on levels to determine time of use and whether under the influence is thought by some as a possible solution. Although some states have established *per se* driving laws (laws that assume a specific threshold above which a person is considered to be “under the influence”), however, it is difficult, if not impossible, to establish a relationship between a person’s THC blood or plasma concentration and performance impairing effects. The concentration of both parent drug and metabolites is dependent on many factors, including patterns of use and dose. Those states that have recently legalized recreational marijuana are also struggling with the “legal” level for driving under the influence. Correlating impairment with urine levels of parent or metabolite, as is often used in workplace testing, is entirely unreliable. This disassociation was highlighted in a media report that assessed driving aptitude as a function of amount of marijuana smoked and corresponding blood level.⁷⁴ States understand the limitation of this approach. Colorado’s *Marijuana DUI Workgroup* went so far as to assert that a 5-ng per se law would be unnecessary, unsupported by the science, and unlikely to significantly improve public safety.⁷⁵

Medical review officers (MROs) are not consistent in how they handle medical or recreational marijuana in the four states (Alaska, Colorado, Oregon, and Washington) that have legalized the drug for recreational use. In individuals tested under federal testing authority, a THC laboratory positive would always be an MRO positive unless the person has a valid prescription for dronabinol or a similar FDA-approved medication (nabilone and other FDA-approved synthetic cannabinoids would generally not produce a laboratory positive for THC).

When presented with a laboratory-positive result for THC, MROs should, as always, pursue with a telephonic interview to investigate the possibility of a legitimate medical explanation. If the donor provides an explanation that includes the use of marijuana for medical purposes, documentation regarding this may be accepted by the MRO with the burden of proof placed upon the donor to provide the information. The MRO must (as is always done when considering what is a “legitimate medical explanation”) determine whether the medical facts corroborate valid medical marijuana use (ie, does it make sense, medically).

In the case of a state where marijuana use is allowed for recreational purposes, obviously, documentation may not exist. In either situation (medical or recreational use), the MRO may elect to verify where the donor is living and working. Medical review officers in almost all circumstances will report these tests out as positive, but in states where medical use or recreational use is allowed, the MRO should make a written notation on their report whether the donor has provided supporting documentation. If the employer has a policy that allows state-permitted use, there still may be a safety concern. Because this may present a situation where marijuana use is allowed under state law but not federal law, this approach leaves the final determination in the hands of the employer as they apply it to their specific employee drug-testing policy.

It cannot be overemphasized that employers should address medical and recreational marijuana use in their respective drug-testing policies and that this should be clearly communicated to both current and prospective employees. Given the variability in state laws, coupled with our ever-increasing mobile society where employees may live and work in different states, this is paramount.

SUMMARY AND CONCLUSIONS

Marijuana shares several limitations of other pharmacologic plants such as poppies, willow bark (the natural source of salicylates), and digitalis leaf, including variable potency, absorption, and bioavailability. As it is currently used for palliation and treatment, the drug does not conform to the safety, consistency, reliability, and proven efficacy standards of FDA-approved medications. This current state does not preclude further study into its health benefits and potential consideration of the development of cannabis or individual cannabinoids along accepted drug approval pathways. At this time the therapeutic future of these compounds is promising, though not yet fully realized.

The intended and unintended physiologic effects of marijuana on neurocognitive performance range from several hours to beyond 28 days of subsequent abstinence. Blood levels may be useful for MRO reporting, but are not reliable for determining whether an individual is impaired. This can only be done by neurocognitive testing. There can be no assurance that neurologic effects in a given user will not persist from the intershift period into the following workday. As such, the use of marijuana by workers cannot be explicitly endorsed by the pharma and MRO working groups.

On the basis of this review, the authors make the following recommendations:

1. It is reasonable and responsible for employers to ban the use of marijuana at any time by employees, contractors, and other workers. Although the prohibition does not at this time conflict with federal law, including the Americans with Disabilities Act, employers must carefully review state law before establishing policy. The review should include antidiscrimination and similar laws, particularly as they apply to the use of marijuana while not at work. In some states, disciplining an employee based solely on a failed marijuana drug test could have legal implications.
2. Given the pace of legal change and emerging case law, and expanding knowledge on risk and benefit, companies should review relevant policies on a regular basis.
3. Approval or tolerance of medical marijuana should not be considered in any industry for which specific federal or state safety standards prohibit its use. This includes industries and companies that are required to adhere to federal drug-testing procedures.
4. Workers who are suspected of being intoxicated with marijuana or any other substance should be removed from the workplace immediately. A whole blood THC level of 5 ng/mL is generally accepted as the legal limit for motor vehicle operation in states where marijuana is legal. THC levels should not uniformly be used in lieu of neurocognitive testing as a determinant of impairment, however. When evidence of impairment exists and blood THC levels exceed 5 ng/mL, this may constitute evidence of THC-induced impairment. Workers who are clinically impaired, but test negative for THC, should undergo a complete medical evaluation for other substances, mental health, and medical causes for the change in function.
5. For employers who decide to accept the use of medical marijuana, the following guidelines should be considered:
 - a. An occupational physician trained and knowledgeable on the impact and evaluation of potentially impairing substances in the workplace should be included, with the legal counsel, in any discussion about company policy or individual use of medical marijuana.
 - b. The employer should establish and consistently apply clear guidelines on the situations for which the use of medical marijuana would be considered. At minimum, employees requesting approval for marijuana use should be required to provide documentation from the authorizing provider containing the following elements:
 - i. Diagnosis or condition that serves as legal validation

- ii. Medical basis for treatment with marijuana
- iii. Schedule of use relative to working hours
- iv. Anticipated route(s) of administration
- v. Recommended work accommodations or restrictions if needed
- vi. Anticipated duration of use
- c. Workers who have been authorized to use marijuana should be required to report any change in product, dose, frequency and timing of use, or route of administration.
- d. Company policy may include a requirement for neurocognitive testing of all workers who use marijuana for medical purposes. Testing should specifically assess residual impairment in the context of work-related risk. Baseline function should be established before the use of marijuana is permitted. Retesting should be considered whenever the worker reports a change in product, dose, frequency or timing of use, or route of administration.
- e. The occupational physician-reviewer along with legal counsel should ensure that the medical condition of the requesting worker matches the current state-approved list. She/he should work with site management to assess the risk of residual impairment and should not approve the accommodation if there is reasonable concern about the safety of the worker, coworkers, or the general public. Considerations of workplace safety in the context of the underlying medical condition for which marijuana has been recommended may also be appropriate. In addition, the following guidelines are recommended:
 - i. Marijuana should not be permitted while an employee is on duty unless the employer can determine with certainty that the associated neurocognitive and judgment impairment will not pose a risk to users, coworkers, or the public. This includes assurance of safe transport to and from the job site.
 - ii. Given the evidence that inhaled THC may impair complex human performance for more than 24 hours after ingestion, employers should not assume that marijuana use between shifts (such as evening use before return to work the following morning) is uniformly safe.
- 6. The authors support research toward improved understanding of the pharmacodynamics, pharmacokinetics, and occupational risks of marijuana use.
- 7. Given dynamics in the legal and scientific landscape, it is important for occupational physicians to frequently review the relevant literature and their approach to workers who use, or may use this form of therapy.

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