



Opinion

# Marijuana: Forensics of Abuse, Medical Uses, Controversy, and AI

Olen R. Brown

Dalton Cardiovascular Research Center, University of Missouri, Columbia, MO 65203, USA;  
brownno@missouri.edu

**Abstract:** Motor vehicle accidents are a significant consequence of marijuana abuse. Limitations of its roadside detection and the forensic problems with establishing impairment require innovations that are scientifically achievable. Marijuana abuse currently is at an all-time high in the United States and its physiological effects make it a popular recreational drug that is reported to be a leading cause of preventable morbidity and mortality among the youth in the 18 most affluent nations. The medical benefits of drugs derived from marijuana complicate its forensic regulation. In an extensive 2017 report by The American Academy of Sciences, the evidence for the medical benefits of delta-9 tetrahydrocannabinol (derived from marijuana) were stated to be conclusive or substantial for the treatment of chronic pain in adults, as an antiemetic for treatment of chemotherapy-induced nausea and vomiting, and for improving patient-reported multiple sclerosis spasticity symptoms. The benefits from treatment for many other medical conditions were inconclusive or absent. The evidence is clear that safely driving a motor vehicle is significantly impaired while under the influence of marijuana. However, there is no roadside forensic test that reliably detects impairment, and there is an urgent need for such to protect the public while insuring the legal rights of users. There is strong societal pressure to relax marijuana's forensic regulation, including removing it from Schedule I of the Controlled Substances Act. Artificial intelligence (AI) should be implemented with appropriate human control to resolve controversies.

**Keywords:** marijuana detection; marijuana abuse; marijuana medication; marijuana forensics; marijuana and AI



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## 1. Introduction

“Nothing is impossible; the word itself says, ‘I’m possible!’”—Audrey Hepburn

“Quitting smoking is easy. I’ve done it a hundred times”.—Mark Twain

Marijuana, as an herbal medicine, has a long history of use that is traceable to about 500 BC, and in America, the colonists grew hemp for textiles and rope [1]. The term marijuana refers to the dried leaves, flowers, stems, and seeds from the hemp plant *Cannabis sativa*. It contains mind-altering delta-9-tetrahydrocannabinol (THC) and other related chemicals. When smoked, a large variety of chemicals are taken into the lungs and bloodstream. Science and the law (forensics) intersect strongly to create current problems in regulating marijuana as a drug of abuse and for its prescription as an ethical drug. The National Institutes of Drug Abuse cited work by Miech et al. [2] that reported “30.7% of high school seniors [in a U.S.A. study] used cannabis (marijuana) in the past year”. This study concluded the following: “Substance use is a leading cause of preventable morbidity and mortality; it is in large part why, among 17 high income nations, people in the U.S. have the highest probability of dying by age 50” [three references are cited]. The authors initially studied 11 separate classes of drugs: marijuana (including hashish), inhalants, hallucinogens, cocaine, heroin, narcotics other than heroin (both natural and synthetic), amphetamines, sedatives, tranquilizers, alcohol, and tobacco. The report described the following: “Substance use is also an important contributor to many social ills including domestic violence, violence more generally, theft, suicide, and more and typically is initiated

during adolescence. It warrants our sustained attention". Obviously, marijuana is only one component of the problem, and the authors described a program focused on young people known as Monitoring the Future (MTF) and stated that it is designed "to give such attention to substance use among the nation's youth and adults. . . It provides the nation with a vital window into the important but often hidden problem behaviours of use of illegal drugs, alcohol, tobacco, and psychotherapeutic drugs". This major study of 527 pages [2] cannot be adequately summarized here. Obviously, much more than marijuana is addressed; however, Table 7-2 (for example) lists the concerning and increasing trend in marijuana use by grade 12.

## 2. Marijuana Recreational Use and Marijuana Regulation

"Believe you can, and you're halfway there".—Theodore Roosevelt

The regulation of marijuana has become a source of deeply divisive controversy. Marijuana is a Schedule I substance of the Controlled Substances Act (CSA), which places various substances into one of five schedules based on medical use, potential for abuse, and their medical safety and risk of chemical dependence [3]. Marijuana has been a Schedule I substance since the enactment of the CSA in 1970. Schedule I substances are most dangerous and have a high risk of addiction with "a high potential for abuse with no currently acceptable medical use in treatment in the United States". The CSA act "prohibits the manufacture, distribution, dispensation, and possession of Schedule I substances except for federal government-approved research studies" [3]. In spite of this, over the past several decades, many states have not followed this mandate for across-the-board prohibition of marijuana and "many have passed laws allowing for some cultivation, sale, distribution, and possession of marijuana" [3].

The Food and Drug Administration (FDA) is responsible for laws regulating its uses, medically and recreationally [4]. Delta-9 tetrahydrocannabinol (THC) is the psychoactive chemical found in the Cannabis sativa plant and it is classified as a cannabinoid, one of more than 100 similar chemicals in the plant. THC is usually manufactured from the cannabidiol (CBD) present in hemp. THC has not been approved by the FDA as safe for use in the formulation of [4] THC-containing products:

"May be marketed in ways that put the public health at risk. . . The FDA received 104 reports of adverse events in patients who consumed delta-THC products between 1 December 2020, and 28 February 2022. . . 55% required intervention (e.g., evaluation by emergency medical services) or hospital admission. . . Adverse events included, but were not limited to: hallucinations, vomiting, tremor, anxiety, dizziness, confusion, and loss of consciousness. . . National poison control centers received 2362 exposure cases. . . between 1 January 2021. . . and 28 February 2022. The FDA noted that during manufacture harmful chemicals may be used and end-up in the final product and production may occur in unsanitary, uncontrolled conditions" [4].

On 6 October 2022, President Biden "announced reform to federal marijuana policy" [and] stated a "pardon [of]. . . all prior Federal offenses of simple possession of marijuana [and] he urged all governors to do the same with regard to state offenses". Biden also "requested that the Department of Justice (DOJ) and Department of Health and Human Services (HHS) initiate the administrative process to review expeditiously how marijuana is scheduled under federal law. . . [and that] important limitations on trafficking, marketing, and under-age sales should stay in place" [3]. The Congressional Research Service insight report [3] noted the discrepancies between federal and state marijuana policies, and noted that both Congress and the Executive Branch can "alter marijuana's status as a Schedule I substance. . . [however,] though [the Administration] is bound by the CSA to consider factors including a substance's medical utility and risk of abuse and dependence prior to altering its scheduling status. . . President Biden's announcement of federal marijuana policy reforms did not itself change the status of marijuana as a Schedule I substance".

Over many years, several organizations have petitioned the Drug Enforcement Administration (DEA) to reschedule marijuana. In 2016, pursuant to a 5-year investigation jointly

with the FDA, the DEA rejected two petitions to reschedule marijuana to a less restrictive schedule [3]. Congress continues to have options to maintain its federal prohibition; it could amend the CSA to move marijuana to a less restrictive schedule, or it could create a new schedule or another category for marijuana. Conflicts between states that have legalized recreational marijuana and the federal government persist.

### 3. Marijuana Medical Effects

“I avoid looking forward or backward and try to keep looking upward”.—Charlotte Brontë

A report issued by The National Academy of Sciences, Engineering, and Medicine [5] and released in 2017 contained 486 pages and was written with contributions by more than a dozen scientists and reviewed by 15 other scientists. The report includes chapters on the history of cannabis and its clinical features, the prevalence of its use and its regulation, therapeutic effects, other health effects, problems with the use of cannabis, and some recommendations. The preface to the report stated the following: “The growing acceptance, accessibility, and use of cannabis raised important public health concerns, and there is a clear need to establish what is known and what needs to be known about the health effects of cannabis use”. The report provided evidence that during the past 20 years, legalization has shifted. 28 states and the District of Columbia have legalized cannabis for the treatment of medical conditions, and a national survey revealed that 22.2 million Americans, 12 years and older, reported using cannabis in the previous 30 days.

This report [5], based on an extensive compilation of medical results, categorized its therapeutic effects as conclusive or substantial for the treatment of chronic pain in adults, as an antiemetic for the treatment of chemotherapy-induced nausea and vomiting, and for improving patient-reported multiple sclerosis spasticity symptoms. The evidence was moderate for improving short-term sleep outcomes with several comorbidities, and there was limited evidence for its effectiveness (that of cannabis and oral cannabinoids) in increasing appetite in HIV/AIDS; improving clinician-measured multiple sclerosis spasticity symptoms (for oral cannabinoids); improving anxiety symptoms (for cannabinoids); and improving the symptoms of post-traumatic stress disorder. There was limited evidence of a statistical association between cannabinoids and better outcomes (in terms of mortality and disability) after traumatic brain injury or intracranial hemorrhage. There was limited evidence that cannabis or cannabinoids were ineffective in improving symptoms associated with dementia (for cannabinoids); improving the intraocular pressure associated with glaucoma; or reducing depressive symptoms in individuals with chronic pain or multiple sclerosis (for dronabinol and two other drugs). There was no or insufficient evidence to support or refute the effectiveness of cannabinoids for treating cancers, including glioma; cancer-associated anorexia cachexia syndrome and anorexia nervosa; irritable bowel syndrome; epilepsy; spasticity with paralysis due to spinal cord injury; the symptoms associated with amyotrophic lateral sclerosis; chorea and other symptoms associated with Huntington’s disease; the motor system symptoms of Parkinson’s or levodopa-induced dyskinesia; dystonia; achieving abstinence in the use of addictive substances; or mental health outcomes in patients with schizophrenia or schizophreniform psychoses.

Cannabis use disorder (CUD) is an underappreciated risk, but it was estimated in a 2021 report in Nature Reviews Disease Primers to affect about 10% of the 193 million cannabis users worldwide and account for a substantial fraction of individuals seeking treatment for cannabis abuse [6].

### 4. Marijuana Detection

“Once you learn to quit, it becomes a habit”.—Vince Lombardi

Marijuana use is growing (it has been reported that as many as 20 million people use marijuana worldwide (an increase of 60% in just a decade) [7], and its unacceptable use while driving is an unavoidable consequence. Indeed, report [7] conveys the opinion that its growing usage is attributable to its legalization and decriminalization around the world.

More than 100 different cannabinoids are present in marijuana but the primary psychoactive component responsible for driving impairment is delta-9-tetrahydrocannabinol. Current roadside tests for impairment are time-consuming and require special training or are based on behavioral signs that may include a police officer's discretion. The most significant problem in detecting marijuana use relative to driving impairment has been expressed succinctly by Marilyn Huestis, a recognized authority at the National Institute on Drug Abuse: "Knowing the time cannabis was last used is important for determining impairment in accident investigations and clinical evaluations" [8]. Indeed, timing is imperative, and positive blood and urine results persist long beyond the time of impairment for driving. Specifically, a detection technology, similar to the way alcohol breathalyzers function, is desirable. One example of progress is a report [7] of a method that "provides the foundation for the development of an electrochemical-based marijuana breathalyzer". It has been demonstrated (nine references are cited in [7]) that the delta-9-THC concentration in the breath correlates reliably with the time of marijuana use for up to 4 h and with blood concentrations. The foundation for a reliable breathalyzer is thus provided, and it is under development.

The consequences of adopting various cut-off values for several substances of abuse including cannabinoids were reported in the article "Driving under the influence of drugs: Prevalence in road traffic accidents in Italy and considerations on *per se* limits" [9]. The most frequently detected drug of abuse was cannabinoids. The authors concluded the following: "The implementation of high analytical limits or *per se* limits based on impairing concentrations in the Italian legislation could result in the prosecution of a much lower number of drugged drivers involved in road traffic accidents, with a decrease from 25% to more than 80% depending on the limits".

### 5. Artificial Intelligence, a Solution to the Marijuana Controversy

"If things go wrong, don't go with them".—Roger Babson

It appears that social authorities, political interests, medical groups, and scientists are not aligned on marijuana by consensus. Artificial intelligence (AI) is rapidly advancing with great promise [10] but it has a darker side also [11]. Humans are not ready to give over control but are rapidly implementing AI to handle large amounts of information in what is called "general" AI, as opposed to special AI, where its application, including for facial recognition or reading radiograms, has proven effective. An example is AI-Descartes, the name given to an "AI scientist" developed by researchers from IBM, Samsung AI, and the University of Maryland Baltimore County [11]. The report states the following: "Researchers already work with AI algorithms to manage large sets of data, and make accurate predictions based on real-world observations". It appears that with proper ground rules in place, the thorny problem of how best to manage the societal uses and medical applications of marijuana and its ethical drug derivatives could be greatly advanced in time, as could the accuracy of assessment with the application of AI. This could be an early forebearer of its successful application, with practical consequences for society.

### 6. Conclusions

"Though no one can go back and make a brand new start, anyone can start from now and make a brand new ending".—Carl Bard

Given current societal and political influences, the abuse of marijuana will continue to increase. There is sufficient conclusive or substantial evidence for treatment with marijuana-derived drugs for chronic pain in adults, chemotherapy-induced nausea and vomiting, and patient-reported multiple sclerosis spasticity symptoms. The scientific evidence strongly supports the retention of marijuana as a drug of abuse in Schedule I. To assist in protecting the public, a reliable roadside test for marijuana impairment is urgently needed. Appropriately controlled medical trials should be continued to establish the conditions that can be beneficially treated with marijuana-derived drugs. All reasonable regulations and efforts should continue to protect the public from marijuana-impaired driving and its recreational

use by immature youths. Artificial intelligence should be immediately implemented with appropriate human controls to evaluate the literature on marijuana with the objectives of directing future research, determining its valid medical uses, implementing effective laws, and providing fair assessment of driving impairment.

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