Department of Justice/Drug Enforcement Administration
Drug Fact Sheet

Vaping & Marijuana Concentrates

WHAT ARE MARIJUANA CONCENTRATES?

A marijuana concentrate is a highly potent concentrated form of THC (tetrahydrocannabinol) that is most similar in appearance to either honey or butter, and commonly referred to or known on the street as "honey oil" or "budder."

WHAT IS ITS ORIGIN?

Marijuana concentrates contain extraordinarily high THC levels that could range from 40 to 80 percent. This form of marijuana can be up to four times higher in THC content than high grade or top shelf marijuana, which normally measures around 20 percent THC levels.

Many methods are utilized to convert or "manufacture" marijuana into marijuana concentrates. One method is the butane extraction process. This process is particularly dangerous because it uses highly flammable butane to extract the THC from the cannabis plant. Given the flammable nature of butane, this process has resulted in violent explosions. THC extraction labs are being reported nationwide, particularly in the western states and in states where local and state marijuana laws are more relaxed.

Marijuana concentrate
Image by Erik Fenderson

What are common street names?

Common street names include:

- 710 (the word "OIL" flipped and spelled backwards), wax, ear wax, honey oil, budder, butane hash oil, butane honey oil (BHO), shatter, dabs (dabbing), black glass, and errl.

What does it look like?

Marijuana concentrates are similar in appearance to honey or butter and are either brown or gold in color

How is it used?

Marijuana concentrates can be mixed with various food or drink products to be consumed orally; however, smoking remains the most popular route of administration by use of water or oil pipes. A disturbing aspect of this emerging threat is the inhalation of concentrates via electronic cigarettes (also known as e-cigarettes) or vaporizers. Many marijuana concentrate users prefer the e-cigarette/vaporizer because it is smokeless, sometimes odorless, and easy to hide or conceal. The user takes a small amount of marijuana concentrate, referred to as a "dab," then heats the substance using the e-cigarette/vaporizer producing vapors that ensures an instant "high" effect upon the user. Using an e-cigarette/ vaporizer to inhale marijuana concentrates is commonly referred to as "dabbing" or "vaping."

What are the Effects of Using Marijuana Concentrates?

Being a highly concentrated form of marijuana, the effects upon the user may be more psychologically and physically intense than plant marijuana use. To date, long term effects of marijuana concentrate use are not yet fully known; but, the effects of marijuana use are known.

These effects include:

- paranoia, anxiety, panic attacks, and hallucinations. Additionally, the use of plant marijuana increases one's heart rate and blood pressure, although prolonged use can produce hypotension. Plant marijuana users may also experience withdrawal and addiction problems.

What is Vaping?

Vaping is the act of inhaling and exhaling an aerosol or vapor made from a liquid or dry material that is heated in an electronic powered device, called an electronic cigarette, or e-cigarette. The liquid can contain flavoring, nicotine, or marijuana concentrates. Dry herb vape devices can heat dry marijuana without combusting it and without using additional liquid. Generally, the vaping device consists of a battery, a cartridge for containing the e-liquid or dry marijuana, and a heating component.

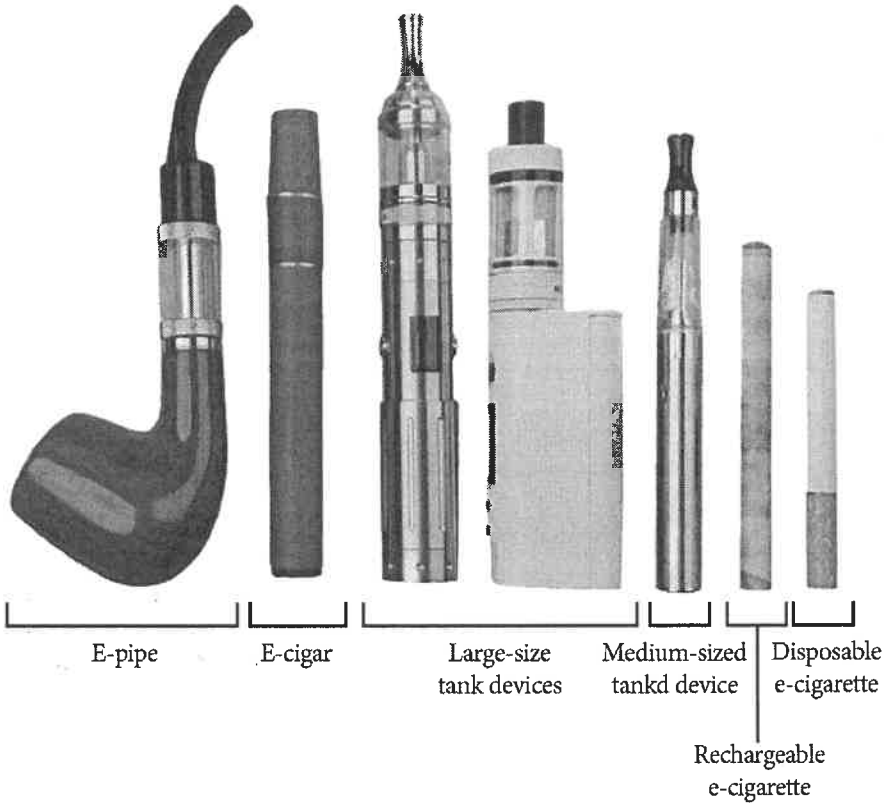
Vaping devices come in a variety of shapes and sizes, with some resembling USB flash drives, pens, or other everyday objects that are often difficult for parents and teachers to recognize.

What are common street names?

- Common street names include: E-cigs, e-hookahs, mods, vape pens, vapes, tank systems, and Juuls or Juuling (after the Juul brand of vaping devices).

What are the effects of vaping?

Vaping is not considered safe, especially for teens and young adults, since the adolescent brain is still developing and inhaling any substance through these devices may be harmful. Additionally, some devices might explode, resulting in burns and other injuries. Most vaping devices contain and release a number of potentially toxic substances including metals and volatile organic compounds from the devices and solvents used. Some of these have been linked to cell and DNA damage.



Source: National Academies of Sciences, Engineering, and Medicine, 2018. Public Health Consequences of E-Cigarettes.

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Cannabis vaping: Understanding the health risks of a rapidly emerging trend

Nicholas Chadi, MD MPH,[1] Claudia Minato,[2] and Richard Stanwick, MD MSc[3,4]

Abstract

The rapid emergence of youth vaping has completely changed the landscape of adolescent substance use in Canada and has become a pressing public health issue of our time. While nicotine remains the most common substance encountered in vaping devices, cannabis vaping is now reported by one-third of youth who vape. Though cannabis vaping is thought to generate fewer toxic emissions than cannabis smoking, it has been associated with several cases of acute lung injury and often involves high-potency forms of cannabis, exposing youth to several acute and long-term health risks. The low perceived riskiness of cannabis as a substance and of vaping as a mode of consumption may bring a false sense of security and be particularly appealing for youth who may be looking for a 'healthier way' to use substances. While research is still lacking on how best to support youth who may have already initiated cannabis vaping, concerted efforts among paediatric providers, public health experts, schools, communities, and families are urgently needed to limit the spread of cannabis vaping among Canadian youth.

Keywords: *Adolescent*, *Cannabis*, *Health risk behavior*, *Injury*, *Substance related disorder*, *Vaping*

The risks of vaping for children and youth were forecasted in a 2015 statement from the Canadian Paediatric Society but the rapidity of uptake of this method of consumption was clearly underestimated (1). While rates of tobacco use in North America have been decreasing steadily and rates of cannabis use among youth under age 18 have trended downwards since the turn of the century, nicotine and cannabis vaping have seen unprecedented increases in popularity among youth in the span of less than a decade (2–4). Nicotine vaping remains more common than cannabis vaping; yet, the overlap between those two substances is significant. In Canada, one-third of adolescents who report e-cigarette use also report using their vaping device to consume cannabis (5).

Youth-friendly designs, aggressive marketing by e-cigarette and cannabis companies, increased access due to legalization, and low perceived riskiness are only some of the factors that may have led to such a rapid increase in popularity of cannabis vaping among youth. Of concern, youth who vape cannabis are at risk of developing e-cigarette or vaping-associated lung injuries (EVALI) (6) and often use very high-potency products, which may lead to more severe health consequences than the use of other forms of cannabis (7).

Cannabis vaping has become one of the most popular modes of cannabis consumption among youth. In this article, we describe cannabis vaping trends and products, discuss some of the specific health risks and youth perceptions of cannabis vaping, and present key clinical considerations for paediatric providers.

EPIDEMIOLOGY

Steady increases in cannabis vaping, which mirror rapid increases in rates of e-cigarette use among youth, have been noted across North America. Although combustible cannabis (i.e., smoked as a joint or using a pipe) remains the most common mode of cannabis consumption among teens (6), cannabis vaping is becoming more and more common among youth. In Canada, the use of vape pens increased from 20% to 26% among adolescents and young adults with cannabis use between 2017 and 2018 (8). Data from Ontario also shows an increase in the proportion of high-school students (grades 9 to 12) who reported cannabis vaping in the past 12 months from 5.1% in 2015 to 6.9% in 2017 (4). Similar trends have been reported in the USA, where lifetime cannabis vaping increased from 4.9% to 7.5% among grade 12 students, 4.3% to 7.0% among grade 10 students, and 1.6% to 2.6% among grade 8 students between 2017 and 2018 alone (9). A recent online survey also found that 44% of American adolescents who had tried cannabis had tried cannabis vaping (10).

According to a recent meta-analysis, use of nicotine containing e-cigarettes increases the odds of cannabis use 3.5-fold among adolescents and young adults, suggesting a strong association between the two substances (11). While nicotine vaping remains more common than cannabis vaping, the boundaries between the two substances appear to be thinning. Importantly, cannabis vaping has been associated with increased amounts of cannabis consumed when compared with other modes of consumption (12).

VAPING PRODUCTS

Cannabis vaping devices come in a wide range of shapes, sizes and designs. They can generally be divided into two categories: dab pens and vaporizers. Dab pens are typically the size of a highlighter and are used exclusively with cannabis concentrates (called dabs) created through butane extraction. This concentrate, referred to as butane hash oil, or butane honey oil (BHO), can take several forms,

from a thick liquid to a firm, almost glassy solid. Dabs are referred to by several colloquial terms such as 'budder', 'earwax', 'honeycomb' or 'shatter' among others (13). Vaporizers, on the other hand, vary more in terms of size (ranging from small flash-drive-like devices to larger tank-like devices) and can be used with either cannabis concentrates or dried or liquid forms of cannabis (14). Mechanisms for both types of devices usually include a small battery, a heating element, a vaporization chamber, a cartridge or reservoir and a mouthpiece. The vaporization process involves heating the desired substance, producing an aerosol, which is then inhaled and absorbed systemically through the respiratory system (14).

Cannabis vaping devices share many similarities with e-cigarettes and other nicotine vaping devices. Specifically, e-cigarettes that come with prefilled liquid cartridges (referred to as 'pod-mods', which can contain nicotine and/or cannabis), make it very simple for adolescents to try vaping one substance or the other (15). Vaporizers and e-cigarettes can also be used to consume other psychoactive substances such as synthetic cannabis (i.e., K2/'spice'), LSD, and bath salts (16). Examples of cannabis vaping devices and their different parts are shown in Figure 1.

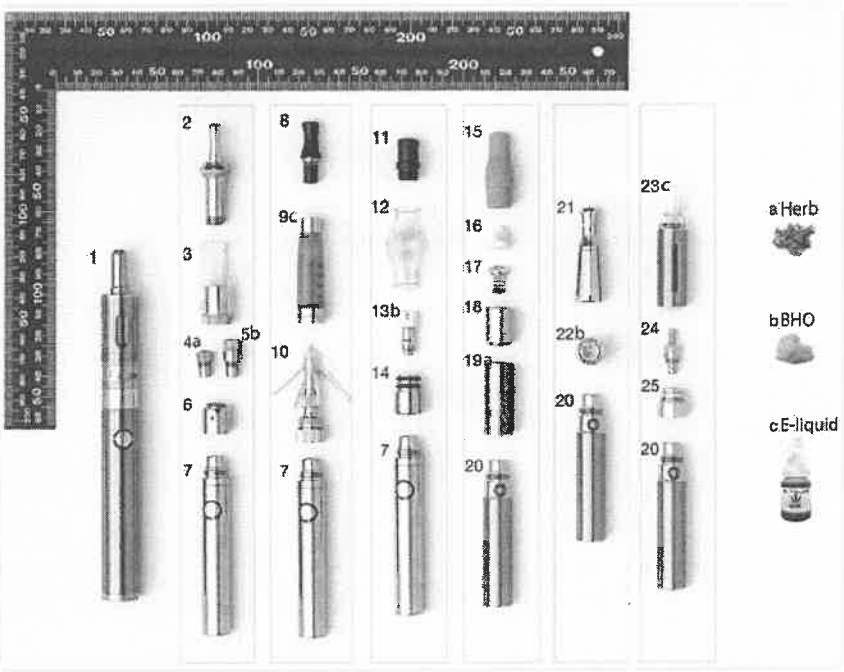

Figure 1.

Examples of cannabis vaping devices and their different parts. Some models of vaping devices for use with (a) ground marijuana head tops; (b) cannabis wax (butane honey oil [BHO] concentrate), or (c) cannabis e-liquid. The letters a, b, or c after the numbers indicate the parts of the vaping devices used for herb, BHO, or e-liquid vaping, respectively. 1. Mega electronic cigarette (e-cig) with dual-coil clearomizer, adjustable airflow control ring, changeable resistance coils and high capacity, variable voltage battery. 2–7. Dry herb and wax vaporizer: 2. Spring-loaded mouthpiece; 3. Vaporizer chamber; 4. Dry herb coil head; 5. Wax coil head; 6. Detachable base with air holes; 7. Medium capacity battery. 8–10. See-through clearomizer for e-liquids: 8. Clearomizer tip; 9. Clearomizer tube; 10. Clearomizer coil and four-wick head with base assembly. 11–14. Glass-globe atomizer wax tank: 11. Drip tip; 12. Glass globe; 13. Ceramic heating chamber and coil; 14. Metal core. 15–19. Dry herb atomizer: 15. Soft drip tip (mouthpiece); 16. Ceramic screen; 17. Metal screen and spring; 18. Screens connector; 19. Ceramic chamber and battery connector. 20. Medium size battery. 21–22. Wax coil head atomizer: 21. Metal mouthpiece and wax coil chamber connector; 22. Wax coil ceramic chamber and battery connector. 23–25. Clearomizer for e-liquids: 23. Shell (mouthpiece attached to metal tank with viewing window); 24. Bottom head changeable coil assembly; 25. Battery base connector. a. Marijuana head tops, b. Cannabis BHO concentrate, c. Cannabis e-liquid (mixture of cannabinoid concentrates (cannabis wax), propylene glycol and glycerol). Source: see ref. (40).

HEALTH EFFECTS OF CANNABIS VAPING

Studies suggest that vaporized cannabis may generate fewer chemicals than smoked cannabis and could thus represent a less harmful, or 'healthier' mode of consumption (17). However, the use of high-potency concentrates, like those found in vape pens also correlates with a higher incidence of mental and physical health problems and may lead to a higher risk of developing acute adverse effects, such as paranoia, psychosis, and cannabis hyperemesis syndrome (18). In addition, there is a lack of evidence comparing long-term effects on lung health of smoked versus vaporized cannabis. In fact, while some vaporizers and vape pens can be used with relatively unprocessed cannabis leaves, buds, or flower, many vaping devices use highly processed products whose safety and chemical profile are much closer to that of e-liquids used in e-cigarettes. This is especially true of flavoured cannabis vaping products which may contain several harmful and carcinogenic aerosols (19). While there is still much to be discovered about the short- and long-term effects of these aerosols on the developing adolescent's lungs, the significant presence of carbonyls, volatile organics, nitrosamines, and heavy metals, all considered toxic and carcinogenic, found in several vaping products, is a reason for concern (20,21).

In recent months, several hundreds of cases of EVALI have been reported in Canada and the USA (6). Most patients diagnosed with EVALI present with severe respiratory symptoms (cough, chest pain, shortness of breath), gastro-intestinal symptoms (abdominal pain, nausea, vomiting, diarrhea) and constitutional symptoms such as fever, chills, and weight loss. EVALI often affects adolescents and young adults with approximately 15% of cases diagnosed in youths under the age of 18 and 20% in youths ages 18 to 20 years (6). While a specific causal agent has not yet been identified, more than three-quarters of individuals diagnosed with EVALI reported vaping THC products, many of which were purchased from the black market (22).

Finally, vape pens and vaporizers present risks related to the device itself. Indeed, reports of injuries tied to the malfunction or explosion of vaping devices have been increasing (23,24). The risk of accidental poisoning in young children who may mistake cannabis vaping products for candies or toys is another important concern, knowing that several of these products come in colourful packages and youth-friendly flavours.

PERCEIVED RISK

The increase in popularity of cannabis vaping among youth likely stems from several factors. Low perceived risk is an important predictor of adolescent substance use and is perhaps one of the most important contributors (25). Vaping devices also tend to be considered more convenient and discreet in public and to have better taste, flavours, and smell than smoked cannabis (16).

Cannabis is considered by youth to be one of the least harmful psychoactive substances, in part because it is often perceived as more 'natural' than other substances (26). Young people also report higher levels of concentration, higher sense of clarity, and better communication skills when using cannabis, though when tested objectively, the opposite is most often found (27). The parallel emergence of legal

'medical' and 'recreational' cannabis markets raises new challenges in understanding adolescent perceptions of cannabis risks and potential benefits. Indeed, many youths interpret the long list of potential indications suggested by medical dispensaries and cannabis companies as a proof of safety and benefit, though evidence is lacking for most of these indications, even in adults (26). As such, the low perceived risk of vaping as a mode of consumption combined with a favourably perceived risk/benefit profile of cannabis as a substance present an appealing combination for youth who may be looking for a 'healthier' way to use substances.

Studies show a high correlation between vaping product advertising and uptake of youth vaping and cannabis use (28,29). Indeed, while youth-targeted advertising for cannabis products is prohibited in North America, adolescents are frequently exposed to cannabis vaping content from unverified sources online and through social media (30). It is well known that teens exposed to multiple forms of advertising are more likely to try vaping than those who aren't (31). Given the high overlap between e-cigarettes and cannabis vaping devices, the aggressive and often uncontrolled marketing strategies from vaping companies and uptake by high visibility public figures has been contributing to increases in both nicotine and cannabis vaping (12).

CLINICAL CONSIDERATIONS

Nicotine and cannabis co-use has been studied long before the recent increase in popularity of e-cigarettes and vaping devices but has now become a more pressing concern among teens given the frequent co-use of those two substances through vaping devices (32). It is well known that nicotine and cannabis addiction share common genetic risk factors, and that the concomitant or sequential use of these two substances can increase severity of withdrawal symptoms and hinder cessation efforts (33). In addition, nicotine consumed through e-cigarettes can enhance the addictive properties of cannabis and other substances, due to its rapid absorption and intense stimulation of the reward centre of the brain. This creates a 'perfect storm' for increased substance use behaviours among youth (11,34).

In order to address what has effectively become an epidemic among youth, health providers will need to seek proper education about nicotine and cannabis vaping products (35). An important first step is to use evidence-based tools to effectively screen for vaping among youth. Since many youth use vaping devices to consume both nicotine and cannabis, the use of a short evidence-based screening tool (36,37) with the inclusion of common vaping terms such as e-cigarettes, vapes, dabs, dab pens, vaporizers, and some of the most common commercial vaping brands will help increase screening effectiveness.

Though more research is needed in this area, therapeutic approaches that apply to smoked cannabis use such as motivational interviewing and individual counseling can be applied to cannabis vaping (38). One important consideration is that given the high potency of cannabis concentrates used in dab pens and vaporizers, youth should be informed about the higher risks of cannabis withdrawal when interrupting use (39).

CONCLUSION

While the risks and health effects of cannabis use during adolescence are well established, low perceptions of harm, especially with vaping devices, often considered 'cleaner' or less harmful than other modes of consumption, represent an important challenge for substance use prevention and reduction efforts. Improved regulation and oversight of the cannabis industry is a promising avenue to limit increases in underage cannabis vaping, but it is only a start. There is an important need for concerted efforts among paediatric providers, public health experts, schools, communities, and families to limit the spread of this rapidly growing trend. One point that will merit attention in upcoming years is the impact of the legalization of extracts of cannabis for vaping in late 2019. The Public Health Agency of Canada currently mentions in its *Lower-Risk Cannabis Use Guidelines* that cannabis vaping could represent a safer mode of consumption than smoking, due to lower toxic emissions. Caution will be needed to prevent young people with a still developing brain from considering this public health messaging and change in policy as an incentive to consume high-potency cannabis products with all their associated health risks.

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Los Angeles is already testing out a saliva swab drug test that can be used at the time of a traffic stop. Officials hope that having a quick and effective method to detect the presence of drugs will deter people from getting behind the wheel while under the influence of any substance.

Looking for More Information?

While the data is limited, researchers are still studying the issue! Take a look at the findings at the links below.

- A study by Columbia University released this past January found that the proportion of fatally injured drivers who tested positive for marijuana tripled from 1999 to 2010, from 4.2% to 12.2%. This may indicate that marijuana-impaired driving is playing an increased role in fatal crashes. The study is based on data from six states where toxicological testing is routinely performed on drivers involved in fatal car crashes.
- In Washington, 25% more drivers tested positive for marijuana in 2013, the first full year after the state legalized the drug, than in 2012. However, there was no overall rise in DUI arrests, and no significant increase in crashes.
- In Colorado, an increased proportion of drivers involved in fatal crashes tested positive for marijuana after 2009, when medical marijuana was legalized, than in the period before legalization. The study did not reveal whether the drivers were found to be impaired at the time of the crash, or whether they were at fault in the crash, so the results may only reflect an increase in use.

Curious about laws on marijuana and driving in your state? Check out NORML's state-by-state list of drugged driving laws.

Overview

More states are passing legislation permitting medical and/or recreational marijuana use, which raises concerns about users driving under the influence of marijuana. This piece will discuss:

- Marijuana consumption and characteristics of marijuana impairment;
- Marijuana legalization's impact on auto accidents;
- Difficulties related to measuring user impairment; and
- Insurance impacts

Historical perspective

Marijuana is a type of hemp plant of the species *Cannabis sativa L.,* part of the genus *Cannabis L.* Unlike industrial hemp, however, marijuana contains appreciable amounts of delta-9-tetrahydrocannabinol (THC), a psychoactive cannabinoid– it's the active chemical that induces user intoxication. The plant also contains several other, non-psychoactive cannabinoids such as "cannabidiol" (CBD).

There is evidence that cannabis has been consumed for thousands of years, often for medicinal purposes. The plant was used as a patent medicine in the U.S. since at least 1850, when the *United States Pharmacopoeia* described the plant for the first time. Cannabis was first regulated under federal law under the Marihuana Tax Act of 1937.

Marijuana was subsequently subjected to countrywide prohibition under the Controlled Substances Act of 1970 (CSA), which established a schedule for substances regulated under federal law. Marijuana is currently a Schedule I drug under the CSA, which defines Schedule I drugs as substances that have "no currently accepted medical use in the United States, a lack of accepted safety for use under medical supervision, and a high potential for abuse." Other substances under Schedule I include heroin, LSD, and peyote.

Despite the treatment of marijuana under federal law, in 1996 California became the first state in the U.S. to pass legislation permitting a medical marijuana program. By April 2021, 36 states and the District of Columbia have passed legislation permitting so-called "comprehensive" medical marijuana programs, which typically allow qualifying patients to access marijuana and marijuana-related products.

Since 2012, 18 states and the District of Columbia have passed legislation permitting anyone over the age of 21 to possess and use marijuana, subject to certain limitations. Most of those states also have or are developing regulations for a commercial market to support recreational marijuana sales.

Marijuana impairment

The THC in marijuana plants causes intoxication in a user. (THC levels in other hemp plants are typically so low that they cannot induce intoxication.)

Effects of marijuana consumption can vary. Marijuana can affect users differently, depending on a variety of factors, including user tolerance. Common experiences while intoxicated include feelings of euphoria and relaxation; some may also experience heightened sensory perceptions and altered perceptions of time.

Marijuana cannot cause overdose, but can potentially cause temporary psychosis. There are no documented instances of an adult dying from an overdose of marijuana alone. However, in rare instances a user may experience a psychotic reaction to the drug or high levels of anxiety – in some cases, these side effects could lead a user to seek medical treatment. Such negative effects are often experienced after consuming edible marijuana products, which are often more potent and take longer to induce intoxication.

Method of consumption alters impairment profile. Several factors influence intoxication onset, intensity, and duration, including method of consumption, type of marijuana product consumed, product potency, and user characteristics.

Marijuana and related products can be consumed in several ways, including **inhalation** (either by smoking or vaporizing) of dried plant matter or concentrates (such as hashish or kief), **oral ingestion** (edibles, capsules, infusible oils), **sublingual ingestion** (lozenges), or **topical application** (lotions, salves, oils).

Smoking often causes almost immediate intoxication, with impairment typically lasting 2 to 4 hours. Intoxication onset is more delayed for other methods, sometimes up to two hours for edibles – and impairment may last much longer.

Product potency is dependent on THC levels. Potency varies considerably across marijuana products and can influence the degree of impairment. Smokable marijuana plant matter can range anywhere from 8 percent to 30 percent THC, whereas high-quality hash oil could reach up to 80 percent THC. There is evidence that marijuana products have become more potent over time.

User characteristics will also influence impairment. For example, chronic users may experience less acute impairment than non-chronic users.

Marijuana and impaired driving

Marijuana intoxication can cause impaired driving, thereby increasing the risks of accidents. Marijuana legalization is associated with an increase in impaired driving.

Marijuana impairment degrades cognition and motor skills. Marijuana alters a user's perception. As such, most studies agree that marijuana use results in impaired coordination, memory, associative learning, attention, cognitive flexibility, and reaction time. Driving ability is thereby degraded to some degree – but by how much remains a matter of study and is subject to several factors, including the level of impairment and user characteristics.

For example, there is some evidence that user impairment may also result in limited "compensatory defensive" driving, in which a user drives more carefully to compensate for a degradation in motor functioning – but this may only mitigate degradation for some skills and may not apply to non-chronic users.

Marijuana impairment increases the risk of accidents. Nonetheless, the evidence suggests that acute impairment increases the risk of traffic accidents – though the magnitude of the increased risk is still a matter of study and can vary widely, depending on the study.

One literature review found evidence that 20 to 30 percent of crashes involving marijuana occurred because of the marijuana use. (This compares to roughly 85 percent of crashes involving alcohol that occurred because of alcohol use.) The review estimated that the crash risk increased 22 percent while under the influence of marijuana, controlling for concurrent alcohol use.

Another review found that someone driving under the influence of marijuana is 1.65 times more likely to be culpable in a fatal accident.

The greater the impairment, the worse the driving abilities. As noted above, level of impairment can influence the degree to which driving ability degrades. Indeed, there is strong evidence that the more impaired the driver, the worse their driving abilities.

Mixing marijuana and alcohol produces additive effects. There is evidence that mixing marijuana and alcohol increases impairment greater than the net effects of each individual substance. There also may exist the possibility for alcohol to increase THC levels. Potential compensatory defensive driving is nullified when a user mixes alcohol and marijuana.

The number of crash rates could increase after legalization. Researchers at the Insurance Institute for Highway Safety (IIHS) and the Highway Loss Data Institute (HLDI) since 2014 have been examining how legalization has affected crash rates and insurance claims, and evidence is emerging that crash rates go up when states legalize recreational use and retail sales of marijuana. The most recent of these studies, released in June 2021 by the IIHS, shows that injury and fatal crash rates in California, Colorado, Nevada, Oregon, and Washington jumped in the months following relaxation of marijuana laws in each state. The five states experienced a 6 percent increase in injury crash rates and a 4 percent increase in fatal crash rates, compared with other Western states where recreational marijuana use was illegal during the study period. However, only the increase in injury crash rates was statistically significant. These findings are consistent with a 2018 IIHS study of police-reported crashes, most of which did not involve injuries or fatalities. This study found that legalization of retail sales in Colorado, Oregon and Washington was associated with a 5 percent higher crash rate compared with the neighboring control states.

Fatal crashes involving drivers who tested positive for THC have increased. Some studies indicate that more people with "detectible" levels of THC in their bloodstreams were involved in fatal accidents after legalization. However, as discussed below, the mere presence of THC does not necessarily indicate marijuana impairment. Furthermore, regarding fatal crash rates overall, at least one study found no significant annual changes in crash fatality rates for Colorado and Washington when compared to 8 control states.

A 2020 study by the AAA Foundation for Traffic Safety shows that the percentage of drivers in Washington involved in fatal crashes who tested positive for marijuana increased 100 percent after the state made the drug legal for recreational use. The study considered the presence of detectable THC in the blood of fatal-crash-involved drivers. In general, the presence of detectable THC in blood suggests, but does not conclusively prove, that a person has recently used cannabis.

Collision claim frequency appears to have increased. Insurance records show an increase in claims under collision coverage, which pays for damage to an at-fault, insured driver's own vehicle, according to HLDI's latest analysis. The legalization of retail sales in Colorado, Nevada, Oregon, and

Washington was associated with a 4 percent increase in collision claim frequency compared with the other Western states from 2012 to 2019. The 4 percent decline is down slightly from the 6 percent increase HLDI identified in a previous study, which covered 2012 to 2018.

Higher risk demographics also have higher rates of marijuana-impaired driving. Younger drivers are at greater risk of traffic accidents than older drivers. Younger male drivers are at high risk of traffic accidents. Early evidence suggests that younger male drivers are most likely to drive under the influence of marijuana.

Use of recreational marijuana impairs driving even when the driver is not high. A study published in the journal Drug and Alcohol Dependence suggests that chronic, heavy use of recreational marijuana impairs driving skills even when the driver is not high. The researchers used a driving simulator to evaluate the potential impact of cannabis use on driving performance. The study concluded that driving impairment was significantly worse among the study participants who began using marijuana regularly before age 16. The study, by researchers at Harvard Medical School's McLean Hospital, found that cannabis users hit more pedestrians, exceeded the speed limit more often, and drove through more red lights compared with non-users. At the time of the study, the marijuana users had not used for at least 12 hours and were not intoxicated.

Determining intoxication: "THC persistence"

A key issue raised in many studies examining the effects of marijuana-impaired driving and its risks is "THC persistence." Unlike alcohol, THC levels in a user's body may not be an accurate indication of impairment.

Compared with marijuana, determining alcohol intoxication is relatively straightforward. The human body processes alcohol at a rate that allows blood alcohol concentration (BAC) to closely correlate with intoxication, making it an effective and accurate benchmark for measuring impairment.

THC presence does not necessarily indicate impairment. The human body processes THC differently than alcohol. As the AAA noted in a major 2016 study, THC can remain in a user's blood or urine for weeks after they consume marijuana, depending on various factors. Furthermore, THC levels spike immediately after consumption, but decline to low levels very quickly – long before impairment ends. It is therefore not currently possible to accurately determine when a user consumed marijuana based on the THC levels in their body.

Additionally, the length and intensity of intoxication depends not only on the strength of the marijuana product, but also on how the drug is consumed. Inhaling marijuana typically causes onset of intoxication within five minutes, with symptoms of intoxication lasting a couple of hours. On the other hand, ingesting marijuana (e.g. "special brownies") can delay onset of intoxication between one to four hours, and intoxication can last much longer than that.

These and other reasons led the AAA to conclude that "simply detecting any THC does not therefore indicate impairment."

A U.S. National Highway Traffic Safety Administration (NHTSA) report came to similar conclusions, noting that most studies have found that levels of THC do not closely correlate to the degree of impairment – and that often peak impairment occurs when THC levels have already begun to decline.

In sum, THC detection in a user post-accident does not necessarily mean that marijuana impairment contributed to a traffic accident.

There is no agreed-upon impairment limit. As noted above, greater impairment leads to worse driving skills. There is some evidence that higher blood THC concentrations are associated with a driver's culpability in an accident. However, there is no agreed-upon impairment limit above which an individual is indisputably impaired.

State responses to marijuana-impaired driving

Some states enforce *per se* limits on THC concentrations. Nonetheless, several states currently enforce *per se* limits to determine marijuana impaired driving, typically 5 ng/ml of THC, though the limit in some states is as low as 1 ng/ml. Operating a vehicle with blood THC concentrations above the *per se* limit is illegal. Colorado enforces a "reasonable inference" standard, in which any THC concentration above 5 ng/ml can be inferred to indicate impairment. (Other states enforce a zero-tolerance policy for THC – any level of THC is prohibited.)

However, *per se* limits have been criticized for their potential to incriminate drivers who are not impaired, since THC can persist for long periods of time in a user. Unfortunately, the opposite may also be true: impaired drivers may not always be prosecuted, since high levels of THC quickly leave the bloodstream before impairment subsides. One study found that only 10 percent of its participants would have been prosecuted for impaired driving, even though many self-reported recent marijuana use.

Furthermore, the time between a roadside traffic stop and subsequent blood testing could take hours, making potential impairment difficult to measure since THC levels might have declined long before testing.

The AAA has therefore concluded that "a quantitative threshold for per se laws for THC following cannabis use cannot be scientifically supported."

Other states use "behavioral evaluations" to help determine impairment. Several states prohibit a driver from being under the influence of THC. In these states, determining whether a driver was marijuana-impaired depends on a variety of evidence, including behavioral evaluations of the driver by a law enforcement officer.

There is currently no scientifically-sound roadside impairment test. There is currently no "breathalyzer"-equivalent for marijuana impairment, in part due to the various difficulties of scientifically measuring impairment outlined above. Some have argued that saliva testing may help in determining THC-levels during a roadside stop, but others have argued that the mere presence of THC still cannot consistently and scientifically determine impairment.

Impact on insurance

Personal auto: the standard personal auto policy does not address driving under the influence of any drug, including alcohol and marijuana. However, auto insurance rates may be impacted by the spread of marijuana legalization, particularly if such legalization is associated with an appreciable increase in

impaired driving and related accidents. An individual's auto insurance rates may rise if they are convicted of driving under the influence of marijuana. Risky driving behavior may also influence rates.

Commercial auto: the standard commercial auto policy also does not address driving under the influence of drugs. However, the U.S. Federal Motor Carrier Safety Administration (FMCSA) governs the drug and alcohol testing rules and regulations for employees driving vehicles that require a commercial driver's license (CDL).

The FMCSA requires employers to test a prospective employee for drugs, including marijuana, before permitting the individual to operate a commercial motor vehicle (CMV). The FMSCA may also require post-accident drug testing in the event of certain vehicle accidents, including those that result in a human fatality.

Random testing throughout the year is also required for CDL operators. Any CMV operator who is under the reasonable suspicion of being under the influence of drugs can be tested immediately. An operator who fails a drug test is prohibited from operating a CMV. The FMSCA prescribes a "return-to-duty" process for such an operator.

Of note, the U.S. Department of Transportation (DOT) has stated that a drug test cannot be verified as negative based on the fact that an employee has been certified to use medical marijuana: "It remains unacceptable for any safety-sensitive employee subject to drug testing under the Department of Transportation's drug testing regulations to use marijuana."

Additional resources

American Automobile Association, "Overview of Major Issues Regarding the Impacts of Alcohol and Marijuana on Driving"

Governors Highway Safety Association, "Drug Impaired Driving"

National Association of Insurance Commissioners, "Cannabis and Insurance"

National Conference of State Legislatures, "Drugged Driving – Marijuana-Impaired Driving"

U.S. Department of Transportation, National Highway Traffic Safety Administration, "Marijuana-Impaired Driving"