

REPORT 4 OF THE COUNCIL ON SCIENCE AND PUBLIC HEALTH (November 2020)
(Resolutions 408-A-19, 411-A-19 and Alternate Resolution 913-I-19)
Public Health Impacts of Cannabis Legalization
(Reference Committee E)

EXECUTIVE SUMMARY

Objective. To review developments in cannabinoid pharmacology, update relevant sections of Council Report 5-I-17, “Clinical Implications and Policy Considerations of Cannabis Use,” and evaluate the public health impacts in states that have legalized cannabis for adult use to determine whether modifications to AMA are warranted.

Methods. English language reports were selected from searches of the PubMed, Google Scholar, and Cochrane Library databases from August 2017 to August 2020 using the (text or MeSh) search terms “marijuana or cannabis or cannabinoid or cannabidiol” in combination with “legalization or laws,” and “health,” “mental or public health,” “addiction or cannabis use disorder,” “health effects,” “use,” “benefits or harms,” “youth or adolescents,” “edibles,” “driving,” “taxes,” “social equity or justice” and “treatment.” Additional articles were identified through related article searches and by manual review of the reference lists of retrieved articles. Websites managed by federal and state agencies, and applicable regulatory and advocacy organizations also were consulted for relevant information.

Results. Thirty-three states have legalized medicinal use of cannabis. Eleven of these states have legalized cannabis for adult use. All 17 states that have not legalized medical use of cannabis allow the use of cannabidiol (CBD) in some way, as does the federal government for CBD products derived from hemp containing $\leq 0.3\%$ Δ -9-tetrahydrocannabinol (THC). The health effects of cannabis and cannabinoids described in Council Report 5-I-17 remain valid; additionally, attention has been drawn to increased cardiovascular risks with cannabis use.

The overall prevalence of cannabis use in the U.S has increased steadily since 2011, mostly among young adults aged 18-25 years and adults 26 years of age and older. Adolescent use has declined during the same time period; findings from state-based surveys in states with legalized adult use contradict to a certain degree patterns reported by national surveys in individual states, but in the fastest growing demographic (18-25 years-old), prevalence of use is highest in states with legalized adult use. Legalization of cannabis for adult use also is associated with increased traffic fatalities, exposures reported to poison control centers (including infants and children), emergency department visits, and cannabis-related hospitalizations. Changes in methods and patterns/intensity of cannabis use in pregnant women are most concerning. Legalization has led to a large decrease in cannabis-related arrests for adults, less so for juveniles, and with limited effects on disparities in that population. States that have legalized cannabis for adult use have garnered increasing revenues on a quarterly/annual basis, with variable portions earmarked for public health measures or designed to address social equity concerns.

Conclusion. Developments in states’ retail cannabis market have advanced more rapidly than public health frameworks to minimize harms. Amendments to current AMA policy are recommended to address these developments.

REPORT OF THE COUNCIL ON SCIENCE AND PUBLIC HEALTH

CSAPH Report 4, November 2020

Subject: Public Health Impacts of Cannabis Legalization
(Resolutions 408-A-19, 411-A-19 and Alternate Resolution 913-I-19)

Presented by: Kira A. Geraci-Ciardullo, MD, MPH, Chair

Referred to: Reference Committee E

1 INTRODUCTION

2
3 This Council report responds to three referred resolutions on cannabis.

4
5 Resolution 408-A-19, “Banning Edible Cannabis Products,” introduced by the Illinois Delegation
6 and referred to the Board of Trustees, asked:

7
8 That our American Medical Association adopt policy supporting a total ban on recreational
9 edible cannabis products;

10
11 Resolution 411-A-19, “AMA to Analyze Benefits/Harms of Legalization of Marijuana,” introduced
12 by the New York Delegation and referred to the Board of Trustees, asked:

13
14 That our American Medical Association review pertinent data from those states that have
15 legalized marijuana; and,

16
17 Alternate Resolution 913-I-19, “Public Health Impacts and Unintended Consequences of
18 Legalization and Decriminalization of Cannabis for Medicinal and Recreational Use,” was adopted,
19 but an additional proposed resolve, referred to the Board of Trustees, asked:

20
21 That our AMA amend Policy H-95.924, “Cannabis Legalization for Recreational Use,” by
22 addition and deletion to read as follows:

23
24 H-95.924, “~~Cannabis~~ Cannabis Legalization of Cannabis Use for Medical or Any Other Purposes for
25 Recreational Use” Our AMA: (1) ~~believes warns~~ believes warns that cannabis is a dangerous drug and as such
26 is a serious public health concern; (2) ~~advocates that cannabis and cannabinoid use are a~~ advocates that cannabis and cannabinoid use are a
27 serious public health concern; (2 3) ~~warns against the legalized use and sale of cannabis and~~ warns against the legalized use and sale of cannabis and
28 cannabinoids due to their potential negative impact on human health ~~believes that the sale of~~ believes that the sale of
29 ~~cannabis for recreational use should not be legalized~~; (3 4) ~~discourages warns against~~ warns against cannabis
30 and cannabinoid use, especially by persons vulnerable to the drug's effects and in high-risk
31 populations such as youth, by children, adolescents, pregnant women, and women who are
32 breastfeeding; (4 5) ~~believes strongly advocates that states that have already legalized cannabis~~ believes strongly advocates that states that have already legalized cannabis
33 for medical purposes or any other purposes ~~(for medical or recreational use or both)~~ (for medical or recreational use or both) should be
34 required to take steps to regulate ~~the product~~ cannabis and cannabinoids effectively in order to
35 protect public health and safety and that laws and regulations related to legalized cannabis use
36 should consistently be evaluated to determine their effectiveness; (5 6) ~~strongly encourages~~ strongly encourages
37 local, state, and federal public health agencies to improve surveillance efforts to ensure data is

1 available on the short- and long-term health effects of cannabis and cannabinoid use; and (6 7)
2 supports decriminalization and public health based strategies, rather than incarceration, in the
3 handling of individuals possessing cannabis or cannabinoids for personal use.
4

5 This report updates relevant sections of Council Report 5-I-17, “Clinical Implications and Policy
6 Considerations of Cannabis Use,” summarizes current state legislation legalizing adult cannabis
7 and cannabinoid use, and reviews other pertinent information and developments in these
8 jurisdictions to evaluate the public health impacts of legalization.¹ The term cannabis will be used
9 throughout when referring to the *Cannabis sativa* plant rather than the slang term
10 marijuana/marihuana, unless the latter is officially included in a title, policy, or otherwise official
11 language.
12

13 METHODS

14
15 English language reports were selected from searches of the PubMed, Google Scholar, and
16 Cochrane Library databases from August 2017 to August 2020 using the (text or MeSh) search
17 terms “marijuana or cannabis or cannabinoid or cannabidiol” in combination with “legalization or
18 laws,” and “health,” “mental or public health,” “addiction or cannabis use disorder,” “health
19 effects,” “use,” “benefits or harms,” “youth or adolescents,” “edibles,” “driving,” “taxes,” “social
20 equity or justice” and “treatment.” Additional articles were identified through related article
21 searches and by manual review of the reference lists of retrieved articles. Websites managed by
22 federal and state agencies, and applicable regulatory and advocacy organizations also were
23 consulted for relevant information.
24

25 CURRENT AMA AND FEDERATION POLICY

26
27 The Council has issued six previous reports on cannabis covering: (1) aspects of research and
28 investigational and therapeutic use (including in-hospital); (2) the juxtaposition of cannabis within
29 the evolution of U.S. national drug control policy; and, (3) the broader clinical implications and
30 policy considerations associated with the proliferation of state-based medicinal and legalized adult
31 use programs.¹⁻⁶
32

33 AMA policy categorizes cannabis as a dangerous drug and public health concern (Policy
34 H-95.924). Accordingly, our AMA supports increased educational programs on the use and misuse
35 of alcohol, marijuana, and controlled substances, including specific measures aimed at K-12
36 curricula (H-170.992).
37

38 With respect to criminal penalties, our AMA believes that public health-based strategies, rather
39 than incarceration, should be utilized in the handling of individuals possessing cannabis for
40 personal use (H-95.924). A plea of cannabis intoxication should not be a defense in any criminal
41 proceedings (H-95.997).
42

43 With respect to research, our AMA calls for further adequate and well-controlled studies of
44 marijuana and related cannabinoids in patients who have serious conditions for which preclinical,
45 anecdotal, or controlled evidence suggests possible efficacy (H-95.952). To facilitate the conduct
46 of clinical research and development of cannabinoid-based medicines, the status of marijuana as a
47 federal schedule I controlled substance should be reviewed and relevant federal agencies should
48 implement measures designed to streamline the clinical research process (H-95.952). The
49 consequences of long-term cannabis use in youth, pregnant women and those who are
50 breastfeeding are special concerns. Our AMA discourages cannabis use, especially in these
51 populations (and in those who are otherwise vulnerable to the drug’s effects), and supports specific

1 point of sale warnings and product labeling about the potential dangers of use during pregnancy
2 and breastfeeding (H-95.924).

3
4 In order to promote public health and safety, research on the impact of cannabis legalization and
5 decriminalization also is encouraged and information derived from such activities should be
6 disseminated. Local, state, and federal public health agencies can assist by improving surveillance
7 efforts to capture relevant data on both short-and long-term health effects of cannabis. Our AMA
8 supports the development of resources on the human health effects of cannabis and on methods for
9 counseling and educating patients on cannabis and cannabinoid use (H-95.924).

10
11 AMA policy otherwise separates cannabis legalization for medicinal (D-95.969) or recreational use
12 (H-95.924). AMA policy opposes state-based legalization of cannabis for medical use (whether via
13 legislative, ballot, or referendum processes) and supports the traditional federal drug approval
14 process for assessing the safety and efficacy of cannabis-based products for medical use. U.S. Food
15 and Drug Administration (FDA) approved cannabinoid products include:

- 16
17 • Dronabinol (Marinol®) is an oral formulation (capsules) containing synthetic delta-9-
18 tetrahydrocannabinol (THC) approved for the treatment of HIV-wasting and chemotherapy-
19 induced nausea and vomiting when conventional treatments are inadequate; a liquified
20 formulation (Syndros®) also is available.
- 21
22 • Nabilone (Cesamet®), a synthetic THC analogue that activates the endogenous cannabinoid
23 type 1 (CB₁) receptor, is an oral formulation approved for the treatment of the nausea and
24 vomiting associated with cancer chemotherapy in patients who have failed to respond
25 adequately to conventional antiemetic treatments.
- 26
27 • Cannabidiol (CBD) oral solution (Epidiolex®) is approved for the treatment of seizures
28 associated with Lennox-Gastaut syndrome, Dravet syndrome, and tuberous sclerosis complex
29 in patients one year of age and older. (Note: AMA Policy H-120.926, “Expedited Prescription
30 Cannabidiol Drug Rescheduling,” supports legislative and regulatory measures designed to
31 expedite the availability of FDA-approved cannabidiol products and to reassert that patient
32 access should be managed like other prescription-only products.)
- 33
34 • Nabiximols (Sativex®) is a 1:1 ratio of THC and CBD, extracted from specially bred cannabis
35 plants and formulated as an oromucosal spray for the treatment of spasticity in patients with
36 multiple sclerosis. This product is approved in 20 countries, including Canada, but remains
37 investigational in the U.S.

38
39 Cannabis products that have not been approved by the FDA (but are marketed for human ingestion
40 in many states) should carry the following warning label: “Marijuana has a high potential for
41 abuse. This product has not been approved by the FDA for preventing or treating any disease
42 process” (D-95.969). Hospitals and health systems also should not recommend the use of such
43 products within their facilities and should educate medical staffs on cannabis use, its effects, and
44 symptoms (withdrawal syndrome) that may appear in patients who abruptly discontinue use. AMA
45 policy also recognizes that physicians may need to engage in a dialogue with their patients about
46 cannabis/cannabinoid use, that such discussions are protected, and that physicians whose behavior
47 conforms to state cannabis laws should not be subject to federal prosecution.

48
49 Our AMA also opposes legalizing the sale of cannabis for adult use and supports stronger public
50 health messaging on the health effects of cannabis and cannabinoid inhalation and ingestion
51 (H-95.924). States that have already legalized cannabis (for medical or legalized adult use or both)

1 should ensure that processes are in place to regulate the product to effectively protect public health
2 and safety with an ongoing evaluation of their effectiveness. A “substantial portion” of tax
3 revenues derived from state-based programs should be used for public health purposes including
4 prevention and treatment of substance use disorders, the aforementioned cannabis-related
5 educational programs, research on the health effects of cannabis use, and public health surveillance
6 efforts.

7
8 The AMA also has policy on addressing synthetic cannabinoids and recognizing new psychoactive
9 substances as a public health threat. The Council addressed these substances in detail in its 2017
10 report, Emerging Drugs of Abuse are a Public Health Threat. Synthetic cannabinoids are outside
11 the scope of this report. Issues relevant to the regulation of CBD are covered in detail in the
12 Council on Science and Health Report on dietary supplements (CSAPH Report 2) being considered
13 at this meeting. As a result, issues related to CBD and are outside of the scope of this report.

14
15 Many medical societies in the Federation have taken positions that are consistent with AMA
16 policy. The California Medical Association (CMA) is one exception. It is on record as urging the
17 legalization and regulation of cannabis to allow for greater clinical research, oversight,
18 accountability, and quality control.⁷ CMA believes that the most effective way to protect the
19 public’s health is to tightly control, track, and regulate cannabis and to comprehensively research
20 and educate the public on its health impacts, not through ineffective prohibition.⁷ CMA policy also
21 opposes policies of health plans, health systems, and hospitals with pain management programs
22 that automatically eliminate patients who use therapeutic cannabis.

23 24 CANNABIS AND CANNABINOID PRIMER

25
26 In order to better understand certain issues surrounding cannabis, substances derived from the
27 plant, their pharmacology, and implications for adult legalization, a brief review is provided.

28 29 *Cannabis Plant*

30
31 *Cannabis sativa* contains a complex array of chemical compounds, including more than 100
32 phytocannabinoids that are exclusively produced in cannabis, and more than 200 terpenoids
33 (comprising “essential oils”) which are responsible for the aroma of cannabis. Phytocannabinoids
34 and terpenoids are synthesized in secretory cells inside glandular trichomes that are most highly
35 concentrated in unfertilized female flowers.^{8,9} THC is the most concentrated phytocannabinoid and
36 the main psychoactive substance; delta-8-THC is similar in potency to THC, but is normally
37 present in only trace amounts.¹⁰ CBD, which possesses its own pharmacologic profile and lacks
38 THC’s intoxicating effects, and cannabidiol are the other major phytocannabinoids; CBD is the
39 most common phytocannabinoid in hemp (fiber) plants.

40
41 Other phytocannabinoids of pharmacologic interest include cannabichromene, cannabigerol,
42 tetrahydrocannabaverin, and cannabidivarin.¹¹ These substances have their own pharmacologic
43 profiles, effects of which are largely unstudied in humans.¹¹ Precursor acid forms of the neutral
44 phytocannabinoids, that break down in the presence of heat, exist in the plant and may be available
45 in concentrated forms in dispensaries in some states; other “secondary” phytocannabinoids isolates
46 have become available as well.

47
48 Selective Mendelian breeding has created cannabis varieties (termed chemovars or chemotypes)
49 with altered concentrations and ratios of phytocannabinoids and terpenes. General categories based
50 on cannabinoid content have been described as THC-predominant (typical of legalized adult use
51 marketplaces), “balanced” THC and CBD varieties, and CBD-predominant; some strains have been

1 created that are enriched in specific terpenes.¹² The average THC content of illicit cannabis samples
 2 confiscated in the U.S. increased from ~4% to 12% between 1995 and 2014.¹³ The majority of
 3 advertised cannabis flower products with both state medicinal and legalized adult use programs
 4 now exceed 15% THC, and some exceed 20% in states with legalized adult use. Genetic
 5 engineering, either via genetic modification of plants or using recombinant DNA in
 6 microorganisms (yeast, bacteria, algae) also is being used to increase yields of THC or CBD, or of
 7 the lesser studied phytocannabinoids.¹⁴ These developments have implications for both the
 8 traditional pharmaceutical industry and the legalized adult use marketplace, and for evaluating both
 9 the risks and harms of cannabis and cannabinoid use in the published literature over time.

10 *Endocannabinoid System*

11
 12
 13 Phytocannabinoids exert their effects, in part, via the endogenous cannabinoid (endocannabinoid)
 14 system. This system comprises two specific neuromodulators that are arachidonic acid derivatives
 15 [anandamide (AEA) and 2-arachidonoylglycerol (2-AG)], enzymes for their biosynthesis and
 16 inactivation, and two transmembrane, G-protein coupled cannabinoid receptors (CB₁, CB₂).^{15,16}
 17 CB₁ receptors are enriched and widely distributed in the brain, and to a lesser extent in peripheral
 18 tissues, in a region specific manner.¹⁷⁻²⁰ See Figure 1 for a summary of the functions that have been
 19 associated with CB₁ receptors. Expressed mainly peripherally on circulating immune system cells,
 20 the spleen, macrophage derived cells, and the liver, CB₂ receptors are normally present in low
 21 concentrations in the brain (brainstem and hippocampus), but following injury or inflammation are
 22 upregulated in reactive microglia and astrocytes where they inhibit neuroinflammation.^{15,18,20}

23
 24 2-AG is an agonist at CB₁ and CB₂ receptors; AEA is a partial agonist at CB₁ receptors and largely
 25 inactive at CB₂ receptors. These substances act in a retrograde manner, being released from
 26 postsynaptic sites, migrating to presynaptic CB₁ receptors and inhibiting neurotransmitter release,
 27 dampening activity within discrete excitatory and inhibitory pathways.¹⁹

28
 29 THC is a partial agonist at CB₁ and CB₂ receptors.^{18,21} CBD is a partial agonist of the CB₂ receptor,
 30 although it also binds to and acts as an antagonist at other non-cannabinoid G-protein receptors.
 31 CBD also inhibits the uptake of AEA and its metabolism and activates TRPV receptors and 5HT_{1A}
 32 receptors. CBD has low affinity for CB₁ receptors, but in low concentrations is capable of
 33 functioning as an effective antagonist (or perhaps as a noncompetitive negative allosteric
 34 modulator) of THC and other 2-AG agonists.^{22,23} Peripherally, activation of CB₂ receptors exerts
 35 anti-inflammatory and immunomodulatory effects, mobilizes hematopoietic stem cells, decreases
 36 gastrointestinal motility, and reduces visceral pain.

37 *Disposition of THC and Cannabidiol Based on Route of Administration*

38
 39
 40 Based on information obtained in pharmacokinetic studies of approved drug products, oral THC
 41 capsules (Marinol®) demonstrate low (6% to 20%) and variable bioavailability among test
 42 subjects. Gastric acidity causes some isomerization of THC to the delta-8-derivative and the drug is
 43 subject to a significant first pass effect. Peak plasma concentrations of THC are achieved within 1
 44 to 6 hours, but may remain elevated for several hours.²⁴⁻²⁷ Initially, THC is oxidized in the liver to
 45 11-hydroxy-THC, a potent psychoactive metabolite, which undergoes further oxidation to the
 46 primary inactive (acidic) metabolite (THC-COOH). Although THC is cleared rapidly by the liver it
 47 has a very large volume of distribution (~10 L/kg).²⁴ Thus, the terminal half-life of THC is on the
 48 order of 20 to 36 hours.^{24,27} With chronic use, the limiting step for the terminal phase of elimination
 49 is redistribution from peripheral tissue storage sites.

1 Following inhalation, THC and CBD are rapidly absorbed into the blood stream and redistributed.
2 Considerable amounts of the dose contained in one cigarette are lost in sidestream smoke and
3 destroyed by pyrolysis.^{24,28} Peak blood levels of THC and CBD are achieved at the end of smoking
4 and then decline rapidly over the next 30 minutes.²⁴ The pharmacokinetics of vaporized and
5 smoked cannabinoids are comparable; however, infrequent users report more pronounced effects
6 with vaping than smoking.^{29,30} Smoked or vaped cannabis is associated with much larger peak
7 plasma THC concentrations, but a shorter duration of effect than orally administered THC. The
8 time course of plasma concentrations after smoking or vaping marijuana is similar to that obtained
9 after intravenous administration.²⁶

10
11 Considerably smaller amounts of 11-OH-THC are formed when THC is inhaled, compared with
12 the oral route.^{24,31} After oral administration of THC, THC-containing edibles, or cannabis-based
13 extracts, the concentrations of THC and 11-OH-THC are much lower than those found upon
14 smoked administration, exhibit marked variability among various preparations, and are slower to
15 reach a peak level; however, they are capable of causing comparable subjective effects and
16 substantial impairment of cognitive/psychomotor functioning.³¹⁻³⁴

17 18 RELEVANT FEDERAL LAW AND POLICY

19
20 Under the U.S. Controlled Substances Act (CSA) of 1970, marihuana remains classified as a
21 Schedule I controlled substance, and the DEA and FDA have reinforced that interpretation,
22 meaning it has no currently accepted medical use in treatment in the United States, a lack of
23 accepted safety for use under medical supervision, and a high potential for abuse.^{35,36} The term
24 “marihuana” means all parts of the plant *Cannabis sativa*, whether growing or not; the seeds
25 thereof; the resin extracted from any part of such plant; and every compound, manufacture, salt,
26 derivative, mixture, or preparation of such plant, its seeds or resin.³⁷ As noted in the introduction,
27 FDA has approved three cannabinoid-based prescription medicines

28
29 Council Report 5-I-17 discussed legal challenges, federal agency findings, and federal policy
30 recommendations that were intended to manage the conflict between federal and state laws and
31 emerging issues on medical or legalized adult use of cannabis. That discussion remains valid with a
32 few notable exceptions and developments.

33
34 Early in the Trump administration, then-Attorney General Jeff Sessions rescinded existing
35 Department of Justice guidance (the Cole Memorandum) that was intended to make clear that state-
36 legalized cannabis was not an enforcement priority. In response, the House of Representatives
37 approved spending bill amendments in both 2019 and 2020 to block the Department of Justice from
38 using its funding to interfere with the implementation of state, territorial and tribal cannabis
39 programs.

40
41 Also, in 2018, the Agricultural Improvement Act (the 2018 Farm Bill) was passed.³⁸ This law
42 removed hemp from the definition of marihuana in Schedule I of the Controlled Substances Act,
43 thereby legalizing the production of hemp under federal law. The bill defined hemp as any
44 cannabis plant, including derivatives or extracts, that contains less than 0.3 percent of THC.³⁸

45 46 STATE LAWS ON CANNABIS

47
48 At the state level, trends in law continue to move from legal prohibition, to decriminalization, to
49 the legalization of medical use of cannabis, to cannabis legalized for adult use (commonly referred
50 to as recreational use).³⁹⁻⁴² To varying degrees these trends have been shaped by arguments that
51 cannabis is less harmful than alcohol and tobacco and may demonstrate certain health benefits; that

1 arrests and criminal convictions for cannabis possession are disproportionately harmful (including
 2 their effect on minoritized populations), and that legalization has the potential to eliminate the
 3 illicit market, enable regulation of use (including product potency and purity), reduce prison
 4 overcrowding, redistribute law enforcement activities, and raise government revenue.⁴³

5
 6 California (CA) was the first jurisdiction in the United States (U.S.) to legalize the use of cannabis
 7 for medical purposes in 1997. Today, 33 states, the District of Columbia (D.C.), Guam, and Puerto
 8 Rico have legalized the use of cannabis for medical purposes through either a legislative process or
 9 ballot measure.³⁹⁻⁴² As described in Council Report 5-I-17, these laws vary greatly by jurisdiction
 10 from how patients access the product (home cultivated or dispensary), to qualifying conditions,
 11 product safety and testing requirements, packaging and labeling requirements, the retail
 12 marketplace, and consumption method. In jurisdictions that have legalized cannabis for medicinal
 13 use, physicians can “certify” or “recommend” a qualifying patient for the medicinal use of
 14 cannabis, but physicians cannot prescribe cannabis for medical purposes because, as a Schedule I
 15 Controlled Substance, it is illegal under federal law. Eleven of these states (and four others without
 16 medical use of cannabis laws) have decriminalized and removed jail time for possession of small
 17 amounts of cannabis.⁴²

18
 19 In 2012, Colorado (CO) and Washington (WA) were the first U.S. jurisdictions to legalize the adult
 20 use of cannabis.^{44,45} At this point, a total of 11 states and D.C. have legalized cannabis for adult
 21 use, ten through the ballot measure process, and two (Illinois [IL] and Vermont [VT]) via
 22 legislation.^{39,41} As noted in the 2017 Council report, most of these jurisdictions have created for-
 23 profit, commercial cannabis production and distribution markets where the product is sold and
 24 taxed; Washington, DC (DC) and VT are exceptions. DC has adopted a “grow and give” model
 25 whereby residents are permitted to possess, use, grow, and give away cannabis, but they cannot sell
 26 it.⁴⁶ VT’s adult use law, passed in 2018, also allows residents to possess recreational cannabis (1
 27 oz) or grow up to six plants (only two mature at a time) but retail sales are currently not allowed.⁴⁷
 28 Possession limits for adult use in other states range from 1 to 2.5 oz of usable cannabis flower, with
 29 most allowing variable numbers of plants, and limits on the amount of hash, solid or liquid infused
 30 products, or concentrates that can be possessed.³⁹ See Figure 2 for a timeline of legalization and
 31 actual implementation.

32
 33 **RETAIL MARKETPLACE: LEGALIZED CANNABIS FOR ADULT USE**

34
 35 As the marketplace for legalization of cannabis for adult use has grown dramatically, an expansive
 36 retail environment has developed with “novel cannabis products, formulations and methods of
 37 administration.”⁴⁸ Different formulations (extracts, concentrates) of cannabis have emerged that
 38 can be smoked, vaporized, or used to create (infused) edibles (e.g., gummy bears, lozenges,
 39 candies, lollipops, brownies/cookies/other foods, and beverages), tinctures and oils for
 40 consumption, as well as topicals.^{49,50} Extracts are a type of concentrate formed by using solvents to
 41 wash the cannabinoid-rich trichomes off the plant and remove phytocannabinoids and terpenes.
 42 Hydrocarbons (e.g., butane, propane), ethanol, or supercritical fluid extraction using CO₂ are the
 43 most common approaches.⁵⁰ Depending on the method, the resulting concentrate comes in various
 44 forms (e.g., waxes, shatter, resin), that can be further processed into various textures (e.g., budder,
 45 crumble, honeycomb). Concentrates made without the use of solvents are produced using
 46 mechanical or physical means to remove and gather trichomes (e.g., hash, kief, rosin). Some
 47 dispensaries also feature products enriched in other phytocannabinoids, most commonly CBD,
 48 cannabidiol, cannabigerol, or tetrahydrocannabinolic acid (THCA) and products that are enriched in
 49 certain terpenes.⁴⁸ See Table 1 for a graphic display and description.

1 THE HEALTH EFFECTS OF CANNABIS AND CANNABINOIDS

2
3 The National Academies of Sciences, Engineering, and Medicine (National Academies, NASEM)
4 published a comprehensive report in January 2017 commissioned by federal, state, philanthropic,
5 and nongovernmental organizations, entitled “The Health Effects of Cannabis and Cannabinoids:
6 The Current State of Evidence and the Recommendations for Research.”⁵¹ The report’s
7 recommendations outline priorities for a research agenda and highlight the potential for
8 improvements in data collection efforts and enhanced surveillance capacity.⁶

9
10 The report contained 98 conclusions based on the accumulated evidence related to cannabis or
11 cannabinoid use and health.⁵⁶ It examined a broad range of possible health effects of cannabis and
12 cannabinoids. Health effects examined included those related to cancer; cardiometabolic risk;
13 respiratory disease; immunity; injury and death; prenatal, perinatal, and neonatal exposure;
14 psychosocial and mental health; problem cannabis use; and cannabis use and the misuse of other
15 substances. The findings were organized into 5 evidence categories: conclusive, substantial,
16 moderate, limited, and no/insufficient evidence.

17
18 *Health Uses:* The report found conclusive or substantial evidence that cannabis or cannabinoids are
19 effective: (1) as antiemetics in the treatment of chemotherapy-induced nausea and vomiting (oral
20 cannabinoids); and (2) for improving patient-reported multiple sclerosis spasticity symptoms (oral
21 cannabinoids); and (3) for the treatment of chronic pain in adults (cannabis).

22
23 The report found moderate evidence that use of cannabis or cannabinoids: (1) are effective in
24 improving short-term sleep outcomes in individuals with sleep disturbance associated with
25 obstructive sleep apnea syndrome, fibromyalgia, chronic pain, and multiple sclerosis
26 (cannabinoids, primarily nabiximols); (2) are associated with improved cognitive performance
27 among individuals with psychotic disorders (history of use).

28
29 The report also found substantial evidence of a statistical association between cannabis smoking
30 and: (1) more frequent chronic bronchitis episodes (long-term cannabis smoking); (2) increased
31 risk of motor vehicle crashes; (3) lower birth weight of offspring (maternal cannabis smoking);
32 (4) the development of schizophrenia or other psychoses, with the highest risk among the most
33 frequent users; and substantial evidence that initiating use at an earlier age and smoking cigarettes
34 (males) as risk factors for progression to problematic cannabis use.

35
36 The report found moderate evidence of a statistical association between cannabis use and:
37 (1) increased risk of overdose injuries, including respiratory distress, among pediatric populations
38 in U.S. states where cannabis is legal; (2) impairment in the cognitive domains of learning,
39 memory, and attention; (3) a number of mental health domains including increased symptoms of
40 mania and hypomania in individuals diagnosed with bipolar disorders (regular cannabis use); small
41 increased risk for the development of depressive disorders; increased incidence of suicidal ideation
42 and suicide attempts with a higher incidence among heavier users; increased incidence of suicide
43 completion; and increased incidence of social anxiety disorder (regular cannabis use).

44
45 In general, the findings and conclusions of this report remain valid. Two additional comprehensive
46 systematic reviews have been published since the NASEM report. A review on cannabis-related
47 harms was in substantial agreement with the NASEM report.⁵² This study also called attention to
48 increased cardiovascular risks associated with cannabis use, prenatal exposure and cognitive
49 dysfunction/behavioral disturbances in offspring, and hyperemesis syndrome. Case studies have
50 linked cannabis use to acute myocardial infarction, cardiac arrhythmias, cardiomyopathies, stroke,
51 and arteritis, mostly in younger men with few cardiovascular risk factors.⁵³ A scientific statement

1 issued by the American Heart Association in August 2020 warned that cannabis use may be linked
2 to an increased risk of heart attacks, atrial fibrillation and heart failure.⁵⁴ A recent retrospective
3 analysis of nationwide inpatient data found that cannabis use was an independent predictor for
4 acute myocardial infarction-related hospitalization in adolescents and young adults.⁵⁵ The other
5 review used evidence mapping and appraisal to evaluate published studies on the therapeutic
6 benefits of cannabis and cannabinoids. This study also was in substantial alignment with the
7 NASEM report.⁵⁶

8 9 PUBLIC HEALTH IMPACTS OF STATE LEGALIZATION OF CANNABIS

10
11 Despite the fact that 11 states and D.C. have now legalized the adult use of cannabis, evaluation of
12 the impacts of legalization on health and safety remain somewhat limited. Retail sales have not
13 commenced in ME, and are not allowed in VT and D.C. Insufficient time has elapsed since retail
14 sales commenced in some states (e.g., IL, Michigan [MI], Massachusetts [MA]) to get meaningful
15 results and/or a state program for formal analysis of post-legalization effects has not been created.
16 Importantly some states established a framework for future analysis by evaluating and compiling
17 various baseline measures (pre-legalization) to be used for comparison (e.g., OR, MI, MA).

18
19 Otherwise, CO [through its Department of Public Health and Environment (CDPHE) and appointed
20 Retail Marijuana Public Health Advisory Committee (RMPHAC)] and WA [in partnership with the
21 Washington State Institute for Public Policy (WSIPP)], and two other states (OR and AK), lead the
22 way on having examined state-specific health and safety outcomes and patterns of cannabis use
23 since legalization. State-based data and surveys, as well as national surveys such as the Substance
24 Abuse and Mental Health Services Administration's (SAMHSA) National Survey on Drug Use and
25 Health (NSDUH) and the Center for Disease Control and Prevention's (CDC) Behavioral Risk
26 Factor Surveillance System (BRFSS), Monitoring for the Future (MTF) and Pregnancy Risk
27 Assessment Monitoring System (PRAMS) have been relied on. Where available larger, state
28 representative surveys that have been implemented longitudinally may be more relevant on certain
29 measures.⁵⁷

30
31 General issues being examined include the impact of legalization for the adult use of cannabis on:

- 32 • patterns of use by children and adolescents, college and university students, other adults,
33 and pregnant women. In youth, monitoring changes in the perceived risk and social
34 acceptability of cannabis and cannabis advertising also has been emphasized;
- 35 • incidents of impaired driving and traffic fatalities;
- 36 • cannabis-related hospital or emergency department visits and other cannabis-related (toxic)
37 exposures;
- 38 • changes in the incidence, costs and treatment for mental health disorders, including
39 treatment admissions for cannabis use disorder;
- 40 • effects on the market for alcohol and other drugs;
- 41 • criminal behaviors (including civil penalties, arrests, prosecution and incarceration); and,
42 government revenues and costs of implementing legalization.

43
44 Considerable attention also has been devoted to the association between medicinal and/or legalized
45 adult use and opioid-related measures and outcomes.

46
47 CO has the most extensive state-based data. Their findings are emphasized for some topics,
48 buttressed with comparable data, where available, from other states that have legalized cannabis for
49 adult use.

1 *General Age-Related Patterns Use*

2
3 In the U.S., the most commonly used illicit drug (based on federal status) in the past year among
4 those aged 12 or older was cannabis, totaling approximately 43.5 million people or 15.9% of the
5 population; nearly 44% of this group are of past month users.⁵⁸ The overall prevalence of cannabis
6 use in the U.S. has increased steadily since 2011 (38% increase), accounted for mostly by increased
7 use among young adults aged 18-25, and adults 26 years of age and older. Annual cannabis use is
8 at historic highs (42.5%) since 2013 among 19-22 year-olds (both college and non-college peers).⁵⁹
9 In 2016, 43% past-month cannabis users who were 18 years and older reported daily or near-daily
10 cannabis use (20 or more days per month), a 30% increase since 2002. This pattern of use declined
11 about 23% in adolescents over the same time period. According to the 2019 MTF survey, there has
12 been an uptake in daily use among younger students (grades 8 and 10) since 2017.⁶⁰ Based on the
13 BRFSS, daily use of cannabis in adults in CO has increased from 6% in 2014 to 9% in 2018, but
14 the methods of use in CO adults have remained fairly constant.⁶¹

15
16 Adolescent use has declined nationally since 2011, remaining fairly steady from 2015 to 2018.⁵⁸
17 Combined NSDUH data for 2017-18 suggest that 6.5% or 1.6 million adolescents (12-17 years old)
18 were current (past month) users of cannabis. The prevalence of past month use in this survey was
19 higher than the national average in CO (9.36%) as well as all other states with legalized adult use;
20 six of these states (WA, VT, OR, MA, Nevada, ME) and DC showed increased adolescent use
21 according to NSDSUH, contrary to the national trend.^{58,62}

22
23 A nationally representative survey of U.S. adults aged 18 years or older using KnowledgePanel
24 concluded that prevalence of past-year use of any form of cannabis is more common among in
25 states with legalized adult use (20.3%) compared with use in medically legal states (15.4%), and
26 nonlegal states (11.9%).⁶³ Perceptions of risk from using cannabis also have continued to decrease.
27 An analysis based on the National College Health Assessment survey also concluded that cannabis
28 use has accelerated to a greater degree among students who attend colleges in states with
29 legalization of cannabis for adult use.⁶⁴

30
31 When examining high school students specifically, state surveys have found higher rates of use and
32 different trends than national surveys. CDPHE in conjunction with the Departments of Human
33 Services and Education conducts the statewide Health Kids Survey. In 2019, the overall current or
34 past 30-day marijuana use prevalence among CO high school students was 20.6% (slightly lower
35 than national estimates based on the Youth Risk Behavioral Survey) but not increasing.⁶⁵ Similarly,
36 according to the Healthy Youth Survey, past month cannabis use across grades 10 and 12 in WA
37 state has decreased since the legalization of the adult use of cannabis, but the prevalence (~18%) is
38 higher than estimates from national surveys.⁶⁶ The OR Health Authority Survey found similar
39 trends (reduced use since legalization) among students in grade 11.⁶⁷

40
41 Although adolescents who use cannabis still prefer smoking, recent changes in the usual methods
42 of marijuana consumption have been documented with the prevalence of dabbing and vaporizing of
43 concentrates increasing in CO, a pattern reflected across other parts of the country.⁶⁸ Data from the
44 online international cannabis policy study conducted in 2018 among 16-19 year-olds found that the
45 prevalence of past 30-day vaping of cannabis was 13.8%. Nearly one-third of these users in the
46 U.S. reported vaping cannabis oil and consuming THC solid concentrates such as wax and
47 shatter.⁶⁹

48
49 These reported increases in the vaping of THC oil as a method of consumption are concerning
50 given the CDC's investigation on the national outbreak of lung injury associated with the use of
51 vaping products.⁷⁰ Among the cases or deaths reported to CDC (in which substance use was

1 available), 82% reported using THC-containing products, 33% exclusively. Sixteen percent
2 reported acquiring products only from commercial sources (recreational and/or medical
3 dispensaries, vape or smoke shops, stores, and pop-up shops); most others were obtained from
4 family/friends, dealers, online, or other sources.

5
6 Increases that have been reported in daily (or near daily) use and changes in consumption patterns
7 with the use of more concentrated products also presents cause for concern. Respondents who
8 report using cannabis daily consume almost twice as much per day compared with those reporting
9 less frequent use.⁷¹ In adolescents with no history of heavy cannabis use, the use of cannabis
10 concentrates is associated with progression to persistent use, more so than the use of other cannabis
11 products.⁷² As noted in CSAPH Report 5-I-17, adolescents are of particular interest in cannabis-
12 policy discussions because the negative health effects of the drug are heightened when use begins
13 in adolescence. In addition to health effects, including the increased risk of cannabis use disorder,
14 evidence also suggests that cannabis use in adolescence and early adulthood is associated with poor
15 social outcomes, including unemployment, lower income, and lower levels of life and relationship
16 satisfaction.⁷³⁻⁷⁵

17 18 *Use among Pregnant Women*

19
20 Cannabis is the most commonly used (illicit) drug during pregnancy, and THC crosses the placenta
21 and is found in breast milk.⁷⁶ Endocannabinoids play an important role in fetal neurodevelopment
22 and in postnatal synaptic plasticity. Preclinical and emerging human evidence suggests that
23 prenatal exposure to cannabis may “lead to subtle, persistent changes in targeted aspects of higher-
24 level cognition”⁷⁷ and neurobehavioral outcomes in children. However, real world evidence is
25 limited to three longitudinal cohorts, with different designs and outcomes, all of which were
26 initiated at a time of much lower (average) THC exposure from cannabis.⁷⁸⁻⁸⁰ Additionally,
27 epigenetic effects of THC have been described.⁸¹

28
29 The American College of Obstetricians and Gynecologists updated its committee opinion in 2017
30 reaffirming that prenatal exposure is associated with low birth weight and discouraging physicians
31 from suggesting the use of marijuana during preconception, pregnancy, and lactation.^{76,82-84} Effects
32 on low birth weight are independent of maternal age, race, ethnicity, level of education and tobacco
33 use during pregnancy.⁸² Infants exposed to cannabis in utero also may be more likely to end up in
34 the NICU or experience preterm birth.^{83,85}

35
36 Overall, based on NSDUH, cannabis use during pregnancy has doubled over the last 15 years with
37 7.0% of pregnant women between the ages of 18 and 44 years reporting past-month cannabis use in
38 2017 compared with 3.4% in 2002; daily or near daily use more than tripled (0.9 to 3.4%).⁸⁶ The
39 majority of use was described as “non-medical” and is most prevalent during the first trimester.
40 Pregnant women may use cannabis to help with nausea or to improve mood, are more likely to
41 perceive it as natural and safe, and are unsure or unaware if cannabis is addictive or if risks are
42 associated with prenatal cannabis use.⁸⁷

43
44 Compared with 2014, PRAMS data for CO showed that among new mothers in 2018, 16.5 percent
45 used cannabis prior to pregnancy (47% increase), 8.2 percent used cannabis during pregnancy
46 (44% increase), and 7.9 percent of breastfeeding mothers used cannabis after delivery (160%
47 increase), all substantially higher than national averages.⁸⁸ Umbilical cord sampling for cannabis
48 metabolites detected prenatal use at an even higher rate than self-reported values.⁸⁹ Cannabis use
49 during pregnancy in CO was statistically higher among women with an unintended pregnancy
50 (12.5%) than among women who intended to become pregnant (4.5%). When cannabis use during
51 pregnancy was compared among different demographics, both education and age showed statistical

1 differences, whereas race and ethnicity did not.⁸⁸ Across three states (AK, CO, WA) that had
2 legalized adult use by 2016, women were more likely to use cannabis during preconception, during
3 the prenatal period, and postpartum, compared with states without legalized adult use.⁹⁰ Clinicians
4 can “play a key role in preventing harms associated with cannabis use in pregnancy by educating
5 patients about the potential risks of frequent use, advising all patients who are pregnant to quit
6 cannabis use, and providing patients with safe and effective medically approved ways to improve
7 mood and treat nausea and vomiting in pregnancy.”⁹¹

8 9 *Impaired Driving*

10
11 A serious consequence of legalizing cannabis for adult use is an increase in traffic crashes and
12 fatalities. Although it is well established that acute THC intoxication impairs driving, CSAPH
13 Report 5-I-17 explained some of the complexities involved with correlating blood concentrations
14 of THC with driving impairment and outcomes, and in establishing legal standards. Unlike alcohol,
15 there is poor correlation between blood or other fluid concentrations of THC or its metabolites and
16 when the cannabis product might have been consumed, and behavioral effects or field sobriety or
17 functional tests for cannabis/THC have not been validated. In CO, about 1 in 5 adults with past
18 month use report driving within 2-3 hours after consumption, a value that has not increased with
19 legalization of cannabis for adult use.⁹² In WA among those 18-25 years of age reporting past year
20 cannabis use, more than 40% reported driving with 3 hours of use at last once, with 1 in 7 reporting
21 such driving on at least 6 occasions.⁹³

22
23 In CO and WA, the THC blood limit for an inference of driving impairment is 5 ng/ml in those 21
24 and older; any detectable amount is considered a violation in individuals less than 21 years of age.
25 Between 2013 and 2018, there has been an increase in traffic deaths in CO in which drivers tested
26 positive for cannabis and an increase in the percentage of all traffic deaths that were presumed to
27 be cannabis related.⁹⁴

28
29 Based on an analysis of traffic fatality rates through 2018 obtained from the most recent report of
30 the National Highway Traffic Safety Administration’s Fatality Analysis Reporting System,
31 legalization was associated with an increase in traffic fatalities compared with the 5 years
32 preceding legalization among the first 4 states to legalize adult cannabis use (CO, WA, OR, and
33 AK).⁹⁵ These states are the only ones that have legalized adult use for which there are at least 2 full
34 years of traffic fatality data available following the opening of retail stores. On a national scale, this
35 rate would translate to an excess 6800 deaths. The calculated rate in this study was comparable to
36 the rate reported after commercialization of retail sales in a previous study of traffic fatalities in CO
37 and WA.⁹⁶ Another recent study that examined data through 2017 and extended the comparison
38 period to 2005 found that traffic fatalities increased (at a lower rate than above) in CO but not
39 WA.⁹⁷ A trend for increased fatalities also may exist in neighboring jurisdictions.⁹⁸

40 41 *Cannabis-Related Exposures*

42
43 Cannabis-related exposures generally refer to the number of human exposures related to either
44 accidental/unintentional or excessive/intentional consumption or inhalation of cannabis and
45 cannabis edibles. Some of these may end up as calls or reports to Poison Control Centers,
46 emergency department visits (which also may report to Poison Control), or hospitalizations.

47
48 Poison Control. The number of calls to Rocky Mountain Poison and Drug Safety (serving CO) with
49 a cannabis mention increased five-fold from 2006 to 2017, stabilizing between 2014 and 2017,
50 when 222 reports occurred, and then increasing somewhat again.⁹⁹ Between January 2017 and June
51 2020, 973 exposures were reported by healthcare facilities and residences, mostly edibles (44.9%),

1 followed by the cannabis plant (29.1%) and concentrates (10.7%). Reporting rates for these
2 substances have remained mostly unchanged since the middle of 2018. Patients ≤ 5 years old
3 accounted for one-third of these reports, and those 6 to 12 years of age accounted for 9%.⁹² In CO,
4 there has been a significant increase since 2014, from 6.9% to 11.2%, in the percentage of homes
5 with children 1-14 years old that reported having cannabis or cannabis products in or around the
6 home.¹⁰⁰ It is estimated that approximately 23,000 homes (or 22.4%) in CO with children 1-14
7 years old had cannabis in the home with potentially unsafe storage, a rate that has increased 60%
8 since 2014.¹⁰⁰

9
10 Since retail sales opened in WA in 2014, calls to the WA State Poison Control Center involving
11 cannabis in 2018 have more than doubled from 245 to 497; reports in children ≤ 5 years of age
12 tripled from 34 to 94 (18.9% of total), and those in children 6-12 years of age more than doubled to
13 31 (6.2% of total).¹⁰¹ Thirty-two percent of cannabis exposure calls involved edibles. Because of
14 these trends, particularly among young children, a new logo was required in 2017 on all cannabis
15 edible packaging (Figure 3). After increasing from 2013-2016, calls reported to OR poison control
16 decreased in 2017 and then started increasing again in 2018; approximately 20% of cannabis
17 exposures in 2017 were in children aged 5 years and under.¹⁰²

18
19 Finally, a recent analysis of all 50 states from 2010-2017 found that an increase in cannabis
20 exposures reported to the U.S. National Poison Data System occurred after commercialization
21 (retail sales) in states with legalized adult use.¹⁰³ The overall magnitude of the increase was 67-
22 77% relative to the pre-legalization average, depending on the composition of comparison states.
23 The relative increases were higher in minors, males, and among those who were classified as
24 suffering medical consequences.

25 26 Cannabis-Related Emergency Department Visits and Hospital Admissions

27
28 In addition to emergency department visits and sometimes hospitalizations for unexpected pediatric
29 exposures to cannabis, emergency department visits and hospitalizations can be prompted by acute
30 intoxication leading to drowsiness/lethargy/confusion, dizziness/vertigo/ataxia, psychotic
31 symptoms, agitation or anxiety, and extreme tachycardia or other cardiovascular events.¹⁰² Chronic
32 use, especially of high potency derivatives, can lead to hyperemesis syndrome, which may require
33 treatment for intractable vomiting, dehydration, and electrolyte abnormalities.¹⁰⁴ In individuals with
34 a *history* of recreational use, the most common reasons for hospitalization were alcohol and drug
35 rehabilitation or detoxification and psychological/psychiatric evaluation.¹⁰⁵

36
37 In an informative analysis, the CO Department of Public Health analyzed rates of cannabis
38 exposures, diagnoses, and billing codes from 2000 to 2016 per 100,000 hospitalizations.⁹² From a
39 baseline rate of 575/100K, hospitalization rates increased steadily to 894/100K when medical
40 cannabis was legalized but not commercialized (2001-2009), experiencing another significant jump
41 to 1,440/100K during the commercialization of medical cannabis (2010-2013), and further
42 increasing again to 2,696 possible cannabis-related hospitalizations per 100,000 during the initial
43 commercial phase of legalized adult use (2014-Sept 2015). An updated analysis indicates that the
44 yearly number of cannabis-related hospitalizations doubled after the initial year of legalized adult
45 use (2013) compared to with 2017.¹⁰⁶ Similar trends were noted in a study of cannabis-related
46 hospitalizations from 2002-2016, a time period covering major changes in WA state policies and
47 marketplace for medical cannabis, legalization for adult use, and then the initial period of retail
48 sales.¹⁰⁷

1 *Cannabis Use Disorder and Related Treatment Admissions*

2
3 A proportion of people who initiate cannabis use eventually meet the criteria for cannabis use
4 disorder (CUD), although the estimated prevalence varies widely depending on the diagnostic
5 criteria and sampling methods that were used. Nevertheless, CUD influences key brain responses
6 and functions relevant to substance use and it manifests as other substance use disorders based on
7 the reinforcing properties of THC, regardless of method of use or formulation.¹⁰⁸

8
9 Epidemiological data indicate that “the majority of those who use cannabis do not have problems
10 related to their use, but a substantial subset of people (using cannabis/THC) do report experiencing
11 symptoms and consequences consistent with a CUD.”¹⁰⁹ Data from the National Epidemiologic
12 Survey on Alcohol and Related Conditions (NESARC) study indicate that the past year prevalence
13 of DSM-IV cannabis abuse and dependence doubled from 1.5% in 2001-02 to 2.9% in 2012-13.¹¹⁰
14 A similar analysis of NSDUH data (DSM-IV criteria) concluded that past year prevalence was
15 relatively unchanged over the same time period (1.6-1.5%).¹¹¹ The disparate findings likely reflect
16 differences in sampling methods (live interview versus online survey) and changes in societal
17 norms over time which may influence respondents.¹¹² Again, depending on the method, between
18 11% (NSDUH, 2016) and 30% (NESARC, 2013) past-year cannabis users met DSM-IV criteria for
19 cannabis abuse or dependence.^{110,112} A recent meta-analysis using DSM-IV or ICD-9 criteria
20 estimated that individuals who use cannabis have a 1 in 5 risk of developing cannabis abuse or
21 dependence and risks increase if cannabis is initiated early and used frequently.¹¹³ Other data
22 suggest that in individual populations, the prevalence of cannabis abuse or dependence roughly
23 doubles for those who initiate use before 17 years of age, and is much higher for adolescents who
24 use weekly or more often.¹¹⁴ Among youth and emerging adults in the U.S., prevalence of cannabis
25 use and dependence appears to increase with time since initiation of use. This increase appears to
26 be steeper for youth than emerging adults. The adjusted 12-month prevalence among youth with
27 lifetime cannabis use ranged from 10.9 in the first year after starting cannabis use, increasing in
28 each year to 20.6% in the fourth year and beyond. Values for young adults (aged 18-25) were lower
29 at all times and increased at a lower rate eventually reaching about 10% four years after
30 initiation.¹¹⁵

31
32 A few previous studies examining the effects of state medical cannabis laws on CUD found mixed
33 results.^{116,117} A study in CO, WA, OR, and AK based on NSDUH surveys from 2008 to 2016 found
34 a small increase in past year cannabis abuse and dependence among respondents aged 12 to 17
35 years, and more significant increases in frequent use and abuse or dependence among adults 26
36 years or older.¹¹⁸ One look back study of the 2012-2014 NESARC study using DSM-5 criteria for
37 CUD estimated that the prevalence of 12-month and lifetime CUD were 2.5% and 6.3%,
38 respectively.¹¹⁹

39
40 In summary, most of the published longitudinal trends on cannabis use disorder are based on DSM-
41 IV criteria for cannabis abuse and dependence, which were combined into one set of diagnostic
42 criteria for DSM-V. The DSM-V criteria for CUD perform similarly to other substance use
43 disorders. Although little is known about how legalization of cannabis for adult use will impact
44 CUD, the availability of high potency products, easy access (cost and proximity), methods of use
45 that are more appealing than smoking, decreased perceptions of risk, and changes in social norms
46 and marketing, all point to a need for vigilance in this area.

1 Treatment Admissions

2
3 Treatment-seeking for CUD comprises a substantial proportion of all substance use treatment
4 admissions. In 2017, cannabis remains by far the most common substance in adolescents seeking
5 treatment; more than 70% percent of publicly funded treatment admissions in individuals aged 12
6 to 17 years were for primary cannabis use.¹²⁰

7
8 Total publicly funded substance use disorder treatment admissions in the U.S. declined about 0.7%
9 from 2007-2017 (see the Treatment Episode Data Set [TEDS-A]).¹²⁰ The proportion of cannabis
10 admissions aged 12 years or older increased from 16% in 2007 to 19% in 2010, before declining to
11 13% percent in 2017. The average age at admission was 27 years among admissions for primary
12 use of cannabis. Non-Hispanic Whites represented 42 percent of admissions, 31 percent were non-
13 Hispanic Blacks, and 20 percent were of Hispanic origin. Consistent with the national picture,
14 cannabis-related treatment admissions in WA declined in the three years following legalization of
15 adult use 2012-2015.¹²¹ In AK, among the approximately 6,800 total people who received public-
16 paid substance dependence treatment in 2018, about 8% (550) received primary treatment for
17 cannabis use disorder, similar to the proportion from 2016-17.¹²² In CO, the overall treatment
18 admission rate for those reporting cannabis as the primary drug has decreased every year from
19 2012-2017, except for a brief uptake in 2014-15 in those 21 years and older.⁹⁴

20 Opioid Use

21
22
23 Increases in unintentional overdoses and deaths due to illicit fentanyl, heroin and prescription
24 opioids remain the biggest drivers of the unintentional overdose death epidemic.¹²³ Nearly 70% of
25 the 67,367 deaths in 2018 involved an opioid.

26
27 Several ecological or epidemiological studies and convenience survey samples have reported
28 population-level associations between the existence of state medicinal cannabis laws and
29 reductions in opioid-related morbidity/mortality, reduced opioid prescribing in Medicaid and
30 Medicare enrollees, as well as subsets of privately insured individuals, self-reported reductions in
31 opioid use (and risks) among medical users (i.e., substitution of cannabis), and intersections
32 between cannabis use and opioids among drivers, including fatalities.¹²⁴⁻¹³² Effects of medical
33 cannabis laws on reducing opioid prescriptions and dampening increases in opioid-related deaths
34 have been linked, in part of the presence and density of dispensary distribution within states.^{126,132}

35
36 A review of 25 such studies concluded:¹³³

- 37 • States that with medical cannabis laws have reported a slower rate of increase in opioid
38 overdose deaths which has persisted over time. Findings are strengthened when controlling
39 for operation of state prescription drug monitoring programs and demographics which also
40 influence patterns of use. The relative contribution of treatment for opioid use disorder in
41 such states is not understood.
- 42 • Some epidemiologic and ecological studies provide evidence that cannabis availability
43 may reduce opioid use and/or harms. Some of these studies are “limited by selection bias,
44 cross sectional designs and reliance on self-reported assessments of the opioid sparing
45 effects of cannabis.”

46
47 While cannabis availability may reduce opioid consumption, based on urine drug testing in patients
48 on chronic opioid therapy, legalization of the adult use of cannabis led to a small increase in
49 positive cannabinoid test results, but compliance with opioid therapy was unaffected.¹³⁴

50 Additionally, in a cross-sectional study of toxicological testing data of drivers from the 2011–2016
51 Fatality Analysis Reporting System (FARS) and the 2013–2014 National Roadside Survey of

1 Alcohol and Drug Use by Drivers (NRS), drivers who tested positive for marijuana were
2 significantly more likely to test positive for prescription opioids.¹³⁵

3
4 CO's legalization of the adult use of cannabis resulted in a significant slowing of the upward trend
5 in opioid-related deaths in 2015 after retail sales were initiated.¹³⁶ This turned out to be a short-term
6 effect as deaths accelerated again in 2016 and 2017. A more recent study of states with medical
7 cannabis laws and with legalized adult use confirmed previous findings of lower prescription rates
8 in Medicare Part D enrollees, with incremental additional decreases in opioid prescribing in states
9 with legalized adult use.¹³⁷ In another study of Medicaid recipients from 2010-2017 among states
10 and D.C., where adult use had been legalized, prescriptions for Schedule III, but not Schedule II
11 opioids were significantly reduced.¹³⁸

12
13 Overall, "it remains unclear whether the presumed benefit of legalizing marijuana in reducing
14 opioid-related harms outweighs the policy's externalities, such as its impact on mental health and
15 traffic safety."¹³²

16 *Social and Criminal Justice*

17
18
19 AMA policy supports decriminalization of cannabis (i.e., reduction in the penalty associated with
20 possession of a small amount of cannabis from a criminal offense subject to arrest to a civil
21 infraction), a view also held by the American Academy of Pediatrics.¹³⁹ Legalization of adult use
22 allows cannabis and cannabinoid products or their legal sale and the removal of all penalties for
23 possession of small amount of cannabis.

24
25 Criminal arrest. One large multistate comparison found that between 2000 and 2016,
26 decriminalization substantially reduced adult and youth arrest rates for cannabis possession (less so
27 for youth), but adult legalization had little or no impact on youth arrest rates.¹⁴⁰ A related outcome
28 that is highly relevant is "whether cannabis legalization can be used to promote social equity and
29 help communities of color that have been and still are disproportionately affected by
30 prohibition."¹⁴¹

31
32 Arrests for cannabis violations have decreased dramatically in states with legalized adult use,
33 falling 90-99% in AK, WA, OR and D.C.¹⁴² In WA, a study that included data only through the
34 initial period of legal adult sales, found that cannabis arrest rates among both African American
35 and White adults decreased significantly and stayed at a dramatically lower rate after the marijuana
36 retail market opened. Cannabis accounted for nearly half (47%) of all criminal drug use cases
37 processed in calendar year 2012 in WA, a number which dropped dramatically to about 12% of all
38 drug cases handled by the police by 2016.¹⁴³

39
40 However, relative disparities in cannabis arrest rates for Blacks increased for those of legal age,
41 and remained unchanged for younger adults.¹⁴⁴ Another study in OR found that adult cannabis
42 legalization was associated with an increase in juvenile cannabis allegations, although relative
43 disparities decreased for Black compared with White youth.¹⁴⁵ AK also reported a modest increase
44 in the number of youth who have been referred to juvenile justice systems for cannabis offenses
45 since 2016.¹⁴⁶ Juvenile offenders engage in both cannabis use and polysubstance use at higher rates
46 than the general adolescent population.¹⁴⁷

47
48 Crime Rates. Cannabis laws more broadly, and the legalization of recreational marijuana more
49 specifically, had minimal effects on violent or major crime in CO or WA or on property crime rates
50 through 2015, except for a decline of burglary rates in WA.¹⁴⁸ This contrasts with reports from the
51 CO Bureau of Investigation of modest upticks in property crimes and a more significant increase in

1 violent crimes beginning in 2016-2018.⁹⁴ Legalization for adult use was associated with increased
 2 resolution of serious crimes in WA even though crime rates were steady as policy devoted more
 3 resources to their clearance.¹⁴³

4
 5 Expungement of Prior Cannabis Related Arrests and Convictions. Even with legalization of
 6 cannabis for adult use, for those who have a cannabis-related criminal record for a minor offence,
 7 the damage persists. Eight states have created a pathway for expungement although it is usually
 8 limited to possession, and may have other limiting conditions (e.g., waiting period, no other
 9 criminal convictions, petition hurdles).¹⁴² IL included automatic expungement for convictions of
 10 possessing 1 oz or less in its bill; individuals can initiate the process and cases are being identified
 11 by law enforcement searches; more than 11,000 have been pardoned.

12
 13 Social Equity in the Legal Cannabis Business. Some states have established social equity programs
 14 to encourage and enable participation (based on a set of criteria) in the cannabis industry by people
 15 from communities that have previously been disproportionately harmed by cannabis prohibition
 16 and enforcement. MA provides free, statewide, technical assistance, and a training program that
 17 provides education, skill-based training, and tools for success in the cannabis industry to
 18 applicants; about 4% of cannabis applications in MA were from self-identified minorities.¹⁴⁹ IL
 19 offers technical assistance and support in creating a business plan and applying for a license, and
 20 also established lower thresholds for license approval, lower fees and access to low interest
 21 loans.¹⁵⁰ IL also has its “Restore, Renew, Reinvest” program for communities that have been
 22 adversely affected by past prohibition efforts. MI offers substantial discounts on applicant, license
 23 and permit fees while expanding eligibility to persons with prior cannabis infractions.¹⁵¹ Certain
 24 other states (e.g., OR) also have eliminated prior cannabis convictions as a disqualification. CA
 25 established a “Community Reinvestment Fund” to support communities disproportionately affected
 26 by past federal and state drug policies.

27
 28 Governmental Costs and Revenue
 29

30 The legalization and commercialization of cannabis results in revenue for states through taxes and
 31 fees, but it also comes with costs, both in regulating and enforcement actions and in protecting
 32 public health and safety. Of the 9 states with active retail sales, six employ cultivation levies on
 33 growers, while all but AK charge an excise tax specifically on cannabis sales. Seven states also
 34 charge a general sales tax and/or allow a local option. Once these laws are fully implemented,
 35 legalized adult-use cannabis programs have generated significant annual sales that continue to
 36 trend upward annually, yielding surpluses from taxes and fees after accounting for the costs to
 37 administer the program. States have implemented adult-use regulatory programs for as little as \$1.8
 38 million (AK) up to \$60 million for CA (medical and adult use together). For a summary of state
 39 administrative agencies, possession limits for legalized adult use, tax rates, recent tax revenues, and
 40 administrative costs see Table 2. In some states (e.g., MA) dispensaries for legalized adult use were
 41 closed for a period of time during early phases of the COVID-19 pandemic. While the creation of
 42 legalized adult use programs leads to reductions in the number of authorized medical users, the
 43 number of medical marijuana patients increased by thousands in MA during COVID closures.

44
 45 How states distribute their cannabis tax revenues also is of interest. Virtually all states allocate a
 46 portion of funds for various cannabis/substance use treatment and education efforts.¹⁵²

47
 48 DISCUSSION

49
 50 The last 20 years have seen a evolution in state laws increasing access to cannabis and cannabis
 51 products to the point where two-thirds of the country now have medical cannabis laws, 11 states

1 among this group and D.C have legalized the adult use of cannabis, and the other one-third have
2 passed laws allowing the use of CBD in some way; Federal regulations also are now permissive for
3 the use and marketing of certain CBD products.

4
5 In trying to evaluate public health impacts in states that have legalized cannabis for adult use, it is
6 important to understand that state retail markets are in different developmental phases to becoming
7 fully established, a process measured in terms of years. All of these states had preexisting,
8 established medical cannabis programs, some more robust than others, especially the states (CO,
9 WA, OR, and to a lesser extent AK) that have provided the most evidence to date. Many studies of
10 the public health impacts of medical cannabis laws exist (and over a longer time period), so it is
11 relevant to question what the appropriate comparison “group” is, especially for states with more
12 recent movement into legalized adult use. In most studies this has been the pre- and post-
13 legalization periods. Some states have set up a process to accomplish this, aided by development of
14 detailed baseline analyses. It is tempting, but premature, to infer that what has happened in the
15 earlier adopter states will be generalizable to other states that have subsequently begun retail sales.
16 One thing that is common is the expansive array of cannabis varieties and novel cannabinoid
17 products and formulations that have been developed, some at very high concentrations,
18 accompanied by an array of administration routes and methods, some posing more health risks to
19 users than others.

20
21 As reviewed in this and other reports on this topic, use of cannabis and cannabinoids are associated
22 with some therapeutic benefits, as well as a range of harms and risks of social consequences. In
23 particular, research into the possible therapeutic uses of cannabidiol is in an expansive phase.
24 Harms and risks of social consequences are much more prevalent in the subset of users with
25 generally recognized risk factors including initiation of use at younger ages, high intensity (i.e.,
26 frequency and potency) and mode of use.¹⁵³ A major difficulty in understanding impacts, risks and
27 benefits of these substances under the umbrella of legalization is the substantial change in potency
28 of products that has occurred over the years, and the range of products now available.

29
30 Nationally, cannabis use has increased in the U.S. among 18-25 year-olds, and adults 26+ but
31 decreased in adolescents. Legalization has not significantly impacted recent patterns of adolescent
32 use, but in the fastest growing demographic (18-25 year-olds), the eight states with highest
33 prevalence of past month use are among those that have legalized adult use (ranging from 30.44%
34 in WA to 37.67% in VT).⁵⁷ Although not specific to states with legalized adult use, it will be
35 important to monitor recent changes in products used, methods of consumption, and intensity of
36 use, as these are predictors of several harmful outcomes.

37
38 Cannabis use in pregnant women has doubled, and women in states with legalized adult use (by
39 2016) were more likely to use cannabis during preconception, pregnancy, and postpartum. It also
40 seems clear that individuals who use cannabis, particularly younger adults, are driving under the
41 influence of cannabis or cannabis products at a fairly high rate, that such use is associated with
42 traffic accidents and fatalities, and these occur in higher rates in states with legalized adult use.

43
44 A robust finding has been the association of legalized adult use with an increase in reported poison
45 control exposures and cannabis-related hospitalizations. Depending on the state, ingestion is the
46 most common route for these exposures, with 20-33% of these reports involving children under the
47 age of 5. In WA, the median age of children (range 0-9 years) was 2 years (2010-2016).¹⁵⁴ In one
48 study involving a children’s hospital in CO, the median age also was 2 years with about half of the
49 exposure due to edibles, usually obtained by the child either due to lack of child-resistant
50 packaging (at the time), poor child supervision or inadequate storage.¹⁵⁵ All states should educate
51 the public in this area and require packaging that is child proof, conveys a meaningful and easily

1 understood unit of consumption, and that clearly differentiates the cannabis edible from food.
2 Incremental increases in cannabis-related hospitalizations have been associated with both medical
3 cannabis laws and legalization of adult use.

4
5 Publicly reported trends in cannabis use disorder and treatment admissions have lagged behind
6 changes in consumption patterns. One would expect increased intensity of use and administration
7 of higher concentrations to eventually become evident. Substantial research into the intersections of
8 cannabis laws and various measures of opioid use and harm has largely been limited to medical
9 cannabis laws; the impact of legalization for adult use, over a sufficient time period is only now
10 being examined. Any protective effects of cannabis availability in this area is probably more than
11 offset by impacts on mental health, cannabis use disorder, driving accidents, and other
12 consequences of cannabis use requiring healthcare and community resources.

13
14 Legalization of cannabis for adult use has led to a large decrease in cannabis-related arrests for
15 adults, but racial disparities still exist, especially in youth, where possession and use are still illegal.
16 Overall effects on crime rates appear to be neither protective nor provocative. Some states have set
17 up processes for expungement of prior cannabis-related convictions, mostly with limited success
18 because of cumbersome processes that may interfere with successful minority participation. Some
19 states have also set up specific programs to advance participation in the cannabis industry by
20 people from communities that have been disproportionately harmed by previous prohibition and
21 enforcement, and some have created funding streams for community development and provision of
22 services.

23
24 Ultimately, the full public health impacts of cannabis legalization will involve the intersection of a
25 number of competing interests including; (1) the regulated marketplace, (i.e., product properties,
26 availability/supply, access/price, preventing youth access, combining current medical and
27 “recreational” markets); (2) impacts on still operating illicit markets; (3) similar to alcohol and
28 tobacco, impacts of advertising, labeling, price and taxes on purchase; (4) effectiveness of public
29 health surveillance and monitoring; and, (5) the extent to which education and community outreach
30 can foster changes in risky behaviors that are subject to individual control.

31
32 With respect to behaviors that are subject to individual control, in addition to general abstinence,
33 and avoidance of use in specific populations (e.g., pregnancy, preexisting mental health disorder),
34 the following set of evidence-based measures for lower risk cannabis use have been previously
35 identified:¹⁵⁶

- 36
37
- 38 • avoid early age initiation of cannabis use (i.e., definitively before the age of 16 years);
 - 39 • choose low-potency tetrahydrocannabinol (THC) or balanced THC-to-cannabidiol (CBD)-
40 ratio cannabis products;
 - 41 • avoid combusted cannabis inhalation and give preference to nonsmoking use methods
42 (e.g., oral solutions/oils, tincture, edibles);
 - 43 • avoid deep or other risky inhalation practices;
 - 44 • avoid high-frequency (e.g., daily or near-daily) cannabis use;
 - 45 • abstain from cannabis-impaired driving, and,
 - avoid combining risk behaviors (e.g., early initiation and high-frequency use).

1 RECOMMENDATIONS

2
3 The Council on Science and Public Health recommends that the following statement be adopted in
4 lieu of Resolution 408-A-19, Resolution 411-A-19, and the additional proposed resolve from
5 Alternate Resolution 913-I-19 and the remainder of the report be filed:

6
7 That Policy H-95.924, “Cannabis Legalization for Recreational Use,” be amended by
8 addition and deletion to read as follows:

9 Cannabis Legalization for ~~Recreational~~ Adult Use (commonly referred to as recreational
10 use)

11
12 Our AMA: (1) believes that cannabis is a dangerous drug and as such is a serious public
13 health concern; (2) believes that the sale of cannabis for ~~recreational~~ adult use should not
14 be legalized; (3) discourages cannabis use, especially by persons vulnerable to the drug's
15 effects and in high-risk populations such as youth, pregnant women, and women who are
16 breastfeeding; (4) believes states that have already legalized cannabis (for medical or
17 ~~recreational~~ adult use or both) should be required to take steps to regulate the product
18 effectively in order to protect public health and safety including but not limited to:
19 regulating retail sales, marketing, and promotion intended to encourage use; limiting the
20 potency of cannabis extracts and concentrates; requiring packaging to convey meaningful
21 and easily understood units of consumption, and requiring that for commercially available
22 edibles, packaging must be child-resistant and come with messaging about the hazards
23 about unintentional ingestion in children and youth. (5) ~~that~~ laws and regulations related to
24 legalized cannabis use should consistently be evaluated to determine their effectiveness;
25 (5~~6~~) encourages local, state, and federal public health agencies to improve surveillance
26 efforts to ensure data is available on the short- and long-term health effects of cannabis,
27 especially emergency department visits and hospitalizations, impaired driving, and
28 prevalence of psychiatric and addictive disorders, including cannabis use disorder; (6~~7~~)
29 supports public health based strategies, rather than incarceration, in the handling of
30 individuals possessing cannabis for personal use; (7,8) encourages research on the impact
31 of legalization and decriminalization of cannabis in an effort to promote public health and
32 public safety; (8,9) encourages dissemination of information on the public health impact of
33 legalization and decriminalization of cannabis; (9,10) will advocate for stronger public
34 health messaging on the health effects of cannabis and cannabinoid inhalation and
35 ingestion, with an emphasis on reducing initiation and frequency of cannabis use among
36 adolescents, especially high potency products; use among women who are pregnant or
37 contemplating pregnancy; and avoiding cannabis-impaired driving; (11) supports social
38 equity programs to address the impacts of cannabis prohibition and enforcement policies
39 that have disproportionately impacted marginalized and minoritized communities, and
40 (10~~12~~) will coordinate with other health organizations to develop resources on the impact
41 of cannabis on human health and on methods for counseling and educating patients on the
42 use cannabis and cannabinoids.

Fiscal note: Less than \$500

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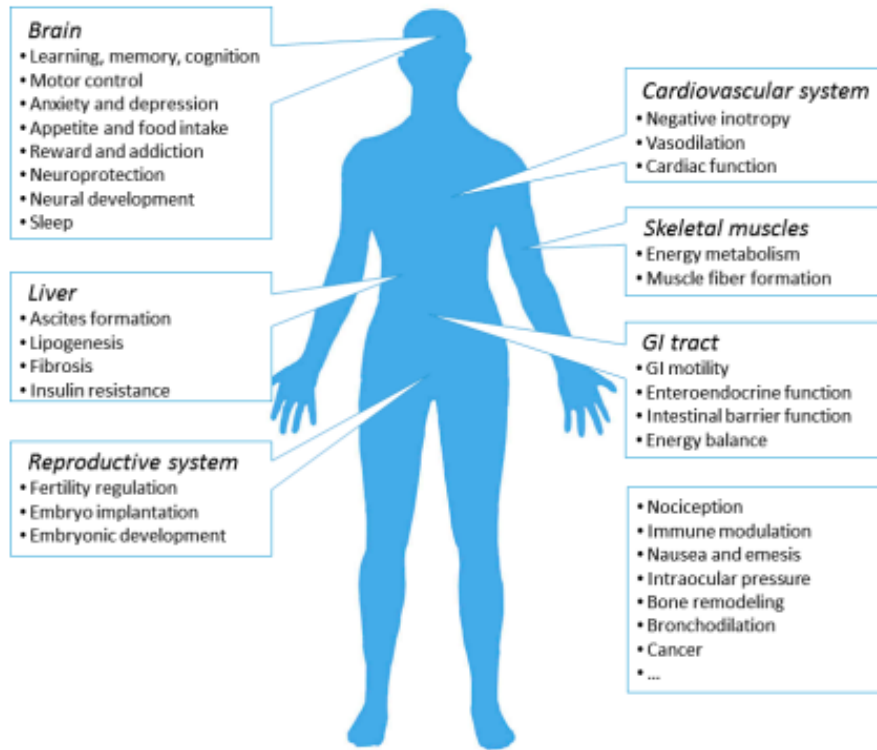


Figure 1. Major localization and associated functions of the CB1 receptor, the majority of which are expressed in the brain from: Zou S, Kumar U. Cannabinoid Receptors and the Endocannabinoid System: Signaling and Function in the Central Nervous System. *Int J Mol Sci.* 2018 Mar 13;19(3):833. doi: 10.3390/ijms19030833. Open Access.

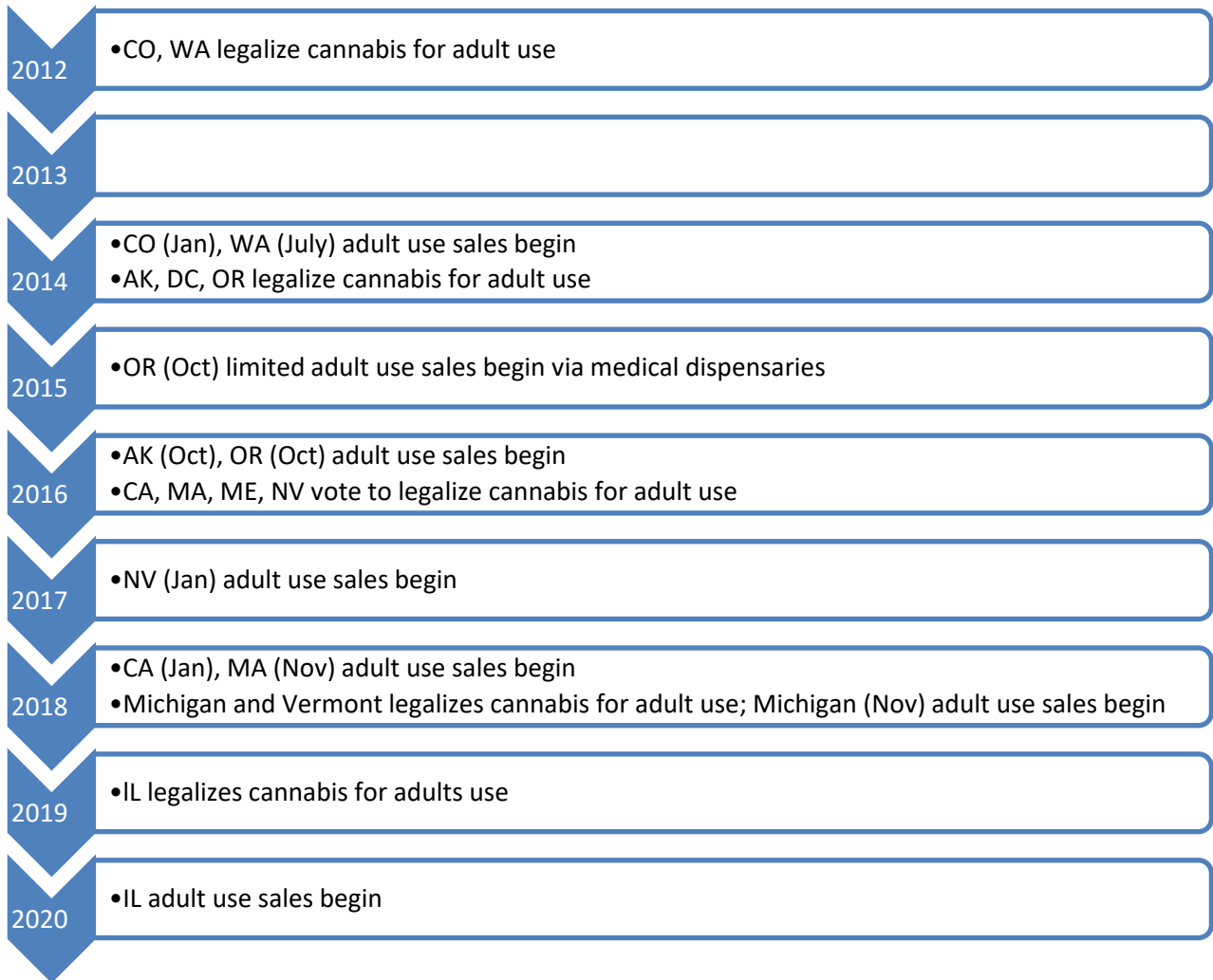


Figure 2. Timeline of legalization and implementation of cannabis for adult use. Constructed figure.



Figure 3. [Washington State logo](#) for cannabis edibles. Washington State Liquor and Cannabis Board

Table 1. Summary of cannabis extracts

Product	Description	Method of Use	Average Levels of THC and CBD ²
Hash			
	Hash or hashish is the oldest and best-known type of cannabis extract. It is a light to dark brown substance composed of compressed or purified trichomes, which are the stalked resin glands that contain most of the cannabinoids present in the cannabis plant. Hash that has been pressed is usually solid, whereas water-purified hash develops a paste-like consistency and is often called "bubble melt hash" or "bubble hash."	- Smoked (either alone or mixed in with dried cannabis or tobacco) - Vaped - Dabbed	THC: 40–80% CBD: less than 5%
Kief			
	Kief refers to the collection of trichomes that accumulate when sifted from dried cannabis, often using a three-chamber grinder.	- Smoked (either alone or mixed in with dried cannabis or tobacco)	THC: 40–50% CBD: less than 5%
Wax (crumble, budder)			
	Wax is a solvent-based (e.g., butane ³) extract that is named after its appearance and consistency. Wax varies in level of THC depending on quality, but can contain well over 50% THC. Crumble is the drier and more crumbly form of wax, whereas budder contains a higher moisture content.	- Vaped - Dabbed	THC: 26–70% CBD: --
Shatter			
	Shatter is amber and glass-like in appearance and consistency. It is generally high in THC and low in CBD. Compression following the extraction process turns shatter into a substance called "cookie crumble" or "honeycomb."	- Vaped - Dabbed	THC: ~ 70% CBD: --
Live Resin			
	Live resin is made the same way as wax, but with fresh cannabis plant material that has been immediately frozen after harvest. This is the reason for the term "live." This process gives live resin a "more intense and complex" smell and taste, so it is more expensive than typical wax and budder products. The moisture in this extract gives it a slightly different appearance from wax and budder.	- Vaped - Dabbed	THC: 40–50% CBD: --
Rosin			
	Rosin refers to cannabis extracts that were made using "rosin tech," which is essentially the application of heat and compression to the resinous sap from cannabis plant matter, most often flower (or bud), kief or hash. This extraction method results in a sappy and translucent cannabis extract that is similar in appearance and composition to shatter . It is believed that rosin can reach comparable THC concentrations to that in solvent-based extracts, but this has yet to be scientifically tested.	- Vaped - Dabbed	THC: ~ 70% CBD: --

Product	Description	Method of Use	Average Levels of THC and CBD ¹
Tinctures and Oil Sprays			
	Tinctures and oil sprays are products consisting of a cannabis extract, a carrier liquid, such as coconut-derived MCT (medium-chain triglycerides) oil, and sometimes terpenes. These products vary widely in their THC and CBD levels and reasons for use. Tinctures come in plastic or glass bottles with droppers and are administered under the tongue (sublingually). Oil sprays are similarly intended to be sprayed under the tongue.	- Sublingual - Ingested	High THC: THC: 20–30 mg/ml CBD: 0–1 mg/ml High CBD: THC: 0.7–2 mg/ml CBD: 15–55 mg/ml Balanced: THC: 1–12.5 mg/ml CBD: 1–12.5 mg/ml
Softgels and Capsules			
	Softgels and capsules are comprised of similar ingredients to that of tinctures and oil sprays: a cannabis extract, a carrier liquid (e.g., MCT) and, sometimes, terpenes. These products vary widely in their THC and CBD levels.	- Ingested	High THC: THC: 2.5–10 mg/capsule CBD: 0–1 mg/capsule Capsules on the illicit market appear to contain up to 100 mg of THC. High CBD: THC: 0–1 mg/capsule CBD: 9–25 mg/capsule Balanced: THC: 2–3 mg/capsule CBD: 2–3 mg/capsule
Vape Cartridges and Disposable Pens			
	Vape cartridges and pens contain high concentrated cannabis extracts and varying terpene (flavour) profiles. High THC vape products are the most commonly sold. However, it appears that high CBD and “balanced” vape products are becoming increasingly available.	- Vaped	High THC: THC: 70–95% CBD: 0–10% High CBD: THC: 0–5% CBD: 60–70% Balanced: THC: 40–60% CBD: 20–40%

Source: Gabrys R. Canadian Centre on Substance Use and Addiction. Clearing the Smoke on Cannabis Edible Cannabis Products, Cannabis Extracts and Cannabis Topicals.
<https://www.ccsa.ca/sites/default/files/2020-05/CCSA-Edible-Cannabis-Extracts-and-Topicals-Report-2020-en.pdf>.

Table 2: Tax rates, recent tax revenues, and administrative cost (adult use)

State	Licensing & Tracking	Possession Limits	Taxes	Tax Revenue	Administrative Costs
Colorado	Colorado Dept. of Revenue	1 oz usable, 6 plants (no more than 3 mature), 8 g hash/concentrates; 800 mg edible	Cultivator excise tax of 15% sales to retail stores Retail tax of 15% Local option retail tax up to 8%	>1 billion in tax revenue from initiation to June 2019; \$203 million for Jan-Jun 2020	\$16 million
Washington	Washington State Liquor and Cannabis Board	1 oz usable, 16 oz solid cannabis-infused, 72 oz liquid infused, 7 g concentrates	37% tax on retail sales 6.5% retail sales tax (plus local tax)	\$395 million in 2019; \$248 million thru Jun 2020	\$42 million
Oregon	Oregon Liquor Control Commission	1 oz usable in public, 8 oz homegrown, 4 plants, 16 oz solid, 72 oz liquid-infused, 1 oz hash/extract at home	17% retail sales tax Local option sales tax up to 3%	\$133 million for FY 2020	\$10 million
Alaska	Marijuana Control Board	1 oz usable, 6 plants (no more than 3 mature)	Cultivator excise tax of \$50/oz flowers; \$15/oz stems and leaves; \$25/oz for immature flowers/buds; \$1 per clone	\$24.5 million FY 2020	\$2 million
Nevada	Nevada Dept. of Taxation	1 oz usable, 6 plants, 3.5 g hash/concentrates	Cultivator wholesale excise tax 15% Retail tax 10% Sales tax 6.85% (plus local)	Jul 2019-May 2020, \$95 million in tax revenue	\$3.5 million
California	CalCannabis Cultivations Licensing (CA Dept. of Food & Agriculture)	1 oz usable, 6 plants, 8 g hash/concentrates	Cultivator tax of \$9.65/ounce for flowers; \$2.87 ounce for leaves Fresh plant material \$1.35/ounce Excise tax (15% of Retail Sales) Retail sales tax (7.25% plus local)	California passed \$1 billion in cannabis tax revenue two years after launching legal market.	\$61 million
Massachusetts	Massachusetts Cannabis Control Commission	1 oz usable (up to 10 oz secured), 6 plants, 5 g concentrates	10.75% Excise tax on retail sales 6.25% Retail sales tax Local option excise tax of up to 3%	\$122 million in tax revenue collected in the FY 2019-2020	?
Michigan	Michigan Dept. of Licensing and Regulatory Affairs	2.5 oz usable, 12 plants, 15 g concentrates	10% Retail excise tax 6% State sales tax	Since Dec 2019, \$35 million in excise/sales tax	?

Illinois	Illinois Dept. of Financial & Professional Regulation	1 oz usable, 5 g hash/concentrates	Cultivator excise tax (7%) on sales to dispensaries Retail Excise Taxes: 10% with THC level of <35%, 25% for THC>35%; 20% on cannabis-infused products; Local option tax up to 3%	\$52.8 million Jan-Jun 2020 with further increase in July	?
Maine	Office of Marijuana Policys	2.5 oz usable, up to 15 plants (no more than 3 mature), 6 g hash/concentrates	Cultivator excise tax of \$335 per pound/ \$94 per pound trim/\$1.50 per seedling/\$0.35 per seed Retail sales tax of 10%	Sales on Hold	