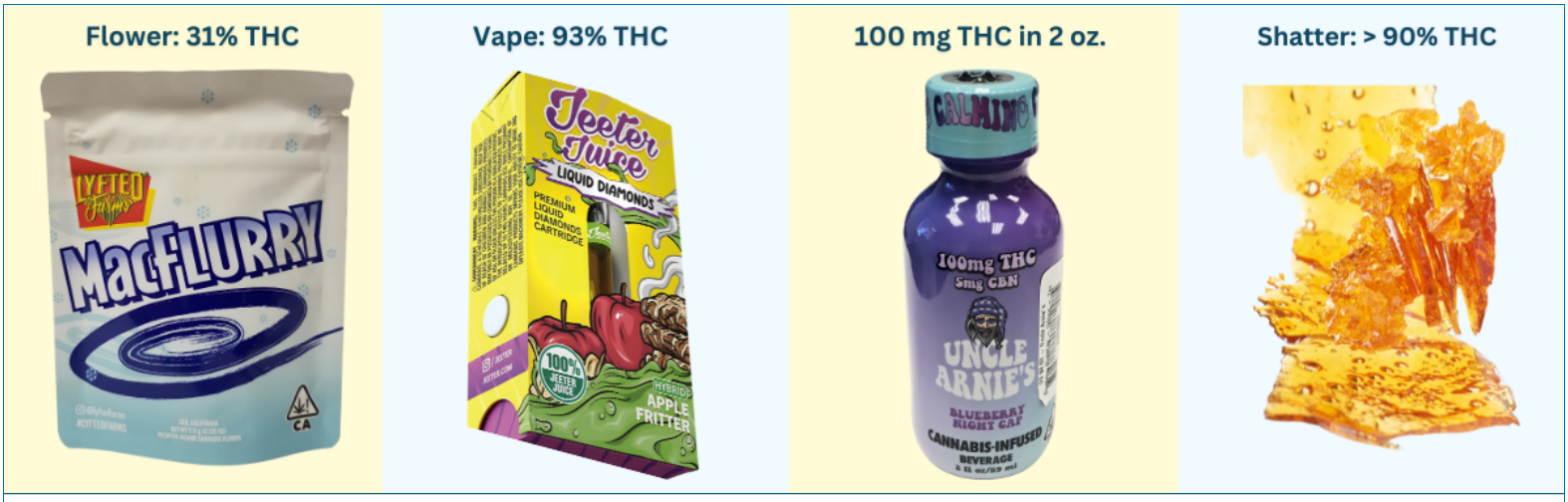

REPORT AND RECOMMENDATIONS OF THE HIGH POTENCY CANNABIS THINK TANK TO THE STATE OF CALIFORNIA

October 30, 2024

Prepared by an independent scientific committee convened by the California Department of Public Health

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This report was prepared by a committee of scientists and medical experts convened by the California Department of Public Health, in response to a Resolution of the Department of Cannabis Control's Cannabis Advisory Committee and a Governor's Directive to provide analysis of the problem of increasing potency of cannabis and cannabis products and to formulate recommendations to address it. The group was also asked to prepare input on implementation of a new legislative requirement (SB540) for consumer information on the issue. The Committee proposed preparing an independent scientific report based on the scientific literature and knowledge of existing policy. This report and its recommendations represent the independent consensus of the scientific committee and do not necessarily represent the official views of, nor an endorsement by, the California Department of Public Health, the California Department of Cannabis Control, or the California State Government.

Acknowledgements: We wish to thank the staff of the California Department of Public Health that convened the Committee and supported our meetings. We would also like to thank the group of 21 external scientific experts who were invited to anonymously contribute to the Delphi panel consultation. We appreciate the assistance of Allison Temourian, PhD. at UCSF and Kiara Gonzalez Garcia at PHI, who supported report formatting. The Committee was co-chaired by members Silver and Allen.

EXECUTIVE SUMMARY

Cannabis "potency" is colloquially used to refer to the concentration (%) or dose (mg) of Δ9-tetrahydrocannabinol (THC) present in cannabis or cannabis products.[1] The potency of legal herbal cannabis (flower) sold in California today is now five to ten-fold the level found nationally in cannabis studied in the 1970s and 80s. Today, most flower and flower products sold by legal California retailers tests at 20% to 24% THC or greater. A wide range of manufactured solid and liquid chemical extract products of up to 99% THC are now sold as vaping liquids, shatter, waxes, or other concentrates or are used in edibles. THC is the primary psychoactive and intoxicating constituent of the cannabis plant. It is the main reason people turn to cannabis for pleasure and to seek relief of certain ills, and yet also the component most associated with adverse effects.

In the summer of 2023, the California Department of Public Health (CDPH) Substance and Addiction Prevention Branch (SAPB) convened a multidisciplinary group of cannabis experts, the High Potency Cannabis Think Tank, (heretofore referred to as "the Committee") to study high potency cannabis. This followed on a 2020 recommendation of the Department of Cannabis Control's Cannabis Advisory Committee that CDPH convene a scientific task force to review the consequences of high potency cannabis and a 2022 directive from Governor Newsom to convene subject matter experts to study the issue. Our key task was to review the research on high potency cannabis and develop policy recommendations to reduce adverse health outcomes related to high potency cannabis in the adult use cannabis market. This report does not focus on the legal medical cannabis market, illicit cannabis, or hemp. The Committee conducted this work using a modified Delphi process, involving iterative rounds of quantitative and qualitative data collection, followed by discussion. This report is the product of that process.

Evidence reviewed by the Committee finds that there is a pattern of increasing risk with increases in THC concentration. The higher the levels of THC in cannabis and cannabis products, the higher the risk of experiencing adverse events and cannabis use disorder. Adverse events may be immediate or acute or the result of longer-term or prolonged use. Adverse events are more common and can be more intense when cannabis consumed contains 10% THC or more in inhaled products, or 10 mg THC or more in edible products. Frequent use, especially daily or near-daily consumption (20+ days per month) increases the risk of both acute adverse events as well as adverse events associated with prolonged use. Use of high potency cannabis increases risks both independently and in conjunction with factors such as frequency of use and individual vulnerabilities, including genetic predisposition to certain mental health conditions, as well as social determinants of health such as access to healthcare adverse childhood experiences, and exposure to racism. By promoting more frequent and problem use, aggressive production and marketing of high potency products indirectly elevate the risk of other adverse effects by making it harder for individuals to moderate or cease use. Cannabis use disorder, itself an adverse outcome, promotes a cycle of heavy use, leading to further adverse outcomes.

Rates of frequent and daily use of cannabis, as well as use during pregnancy, have risen dramatically in recent decades, and the number of people who use cannabis daily now surpasses the number of people who drink alcohol daily seven-fold.

Use of high potency cannabis may be especially harmful for certain populations, including people under the age of 26 whose brains are still maturing, those who are pregnant and their infants, and people with a

[1] This is done using a formula that includes the precursor tetrahydrocannabinolic acid or THCa.

personal or family history of mental health conditions or substance use disorders. These adverse outcomes have a high human and financial cost to individuals, families, government, and society at large that often passes unperceived.

Given the migration of the California market to high and very high potency cannabis, strategies to mitigate adverse health, educational, and social impacts must be holistic. These strategies should not only address the potency of the products themselves but also focus on increasing public awareness, promoting safer use, and reducing exposure among the highest-risk groups.

The Committee recommends twenty interdisciplinary policies that have the potential to reduce adverse health outcomes related to high potency cannabis (Table 1). A set of the "top ten" policies in terms of their likely impact on adverse outcomes are highlighted in green. These policy recommendations are based on the existing body of scientific research, experience to date in cannabis markets, and our collective professional experience. They take into consideration policies that have been adopted by other states and countries. In developing the recommendations, we sought policies that would not contribute to stigma related to cannabis use, nor recreate past inequitable patterns of penalization, focusing primarily on addressing the supply side, pricing, and educating consumers. We also aimed to be realistic about the status of California's legal retail market, where almost the entire market is now composed of high potency products; seeking policies that are feasible to implement, most of which have been implemented elsewhere. Where possible we recommend policies that will reduce adverse health outcomes by discouraging products with excessive levels of THC and incentivizing the availability of lower THC retail offerings. Throughout, our priority was to recommend policies to protect young people, people who are pregnant, and people with a personal or family history of mental health conditions or substance use disorders.

Control policies for illicit drugs focus on criminal sanctions for sales, possession, and use, whereas control policies for legal drugs focus on product regulations, marketing, sales policies, information, and taxation. Given that cannabis is now legal in California, it is an appropriate time to review initial regulatory policies aimed at establishing the legal market with a greater focus on ensuring the health and safety of consumers.

Recommended policies are related to marketing and advertising; product requirements; the retail environment; taxation and pricing; attractiveness to children, packaging, labeling, and consumer information; public education; and compliance screening, data collection, and research and evaluation. "Cannabis product" in California means cannabis that has undergone a process whereby the plant material has been transformed into a concentrate. This refers to edibles, vape oils, other concentrates, infused pre-rolls, and other products. Our recommended approach also includes funding of evaluation research and epidemiologic surveillance alongside policy implementation, to assess the effect of cannabis policy on adverse health outcomes from high potency cannabis and inform future steps. Similar approaches have led to historic declines in alcohol and tobacco use by adolescents.

We recognize that the recommended policies differ in their cost and technical complexity. Yet, once implemented, many have little ongoing cost to government, whereas the costs of inaction are substantial and continuous. Each of these policies has value to protect public health and youth.

The state may experience pushback in working to implement these policies from those who say that the available evidence is not sufficient to support their implementation. We acknowledge that the body of evidence in support of these policies is still emerging, although copious evidence exists from tobacco and

alcohol control for some recommendations. This reflects the rapidly shifting product and policy landscape characterizing cannabis in the United States. However, continuing to choose not to act is as much a policy choice as implementing new policies, and one with significant negative implications for mental health, substance use disorders, and other areas.

We have passively allowed the shift of our cannabis markets to far more potent products likely to cause significantly greater harm. It is time to change course and acknowledge that not all substances that can be derived from cannabis can be treated as safe consumer products. As a state, we have an interest in building a safer legal cannabis market for the long-term, one in which well-informed consumers can have greater confidence, and which provides legal access to products, packaging, and marketing less likely to induce harmful patterns of use, dependency or other harms.

We urge the State of California, including its cannabis regulatory agency, state legislature, public health agency, and taxation authorities to work together to immediately implement as many of these policies as possible.

Table 1. *Recommended Policies to Reduce Adverse Health Outcomes Associated with High Potency Cannabis*

Recommended Policies to Reduce Adverse Health Outcomes Associated with High Potency Cannabis **"Top ten" policies in terms of their likely impact are marked in green**
Marketing and Advertising
Prohibit cannabis and cannabis product advertising on billboards, and any other general public-facing advertising (Because billboard advertising reaches children, and because a high percentage of the market is high potency).
Restrict advertising of cannabis flower with over 20% THC or cannabis products with over 35% THC to simple plain text only.
Product Requirements
Limit manufacture and sale of high THC products. Specifically: Prohibit the sale of liquid or solid concentrates for inhalation (e.g. dabs, wax, shatter) with THC content above 60% and implement careful oversight of allowable vehicles and diluents to ensure safety. Prohibit the sale of cannabis flower with THC content above 25% and prohibit the infusion of additional THC (or other psychoactive cannabinoids) into flower or pre-rolls. Limit edible products to a maximum of one 10 mg THC dose per physical piece or liquid beverage container (excluding tinctures).
Prohibit the use of added flavors (including fruits, mint, menthol, vanilla, chocolate, spices, and other common food flavors) in all inhaled products, whether natural or synthetic. Additionally, prohibit language and images that could lead consumers to believe the product has flavors other than those of cannabis. At a minimum, this should apply to flower or pre-rolls with THC content above 20% and other inhaled products with THC content above 35%.
Retail Environment
Require retailers to offer lower dose options for flower (<10% THC) and edibles (5 mg or less), including products which are more suitable for medical use.
Consider testing, promoting, or facilitating a Quebec-style public monopoly approach to cannabis sales, particularly in jurisdictions that have not yet legalized cannabis sales.

Require more robust age-gating for websites, online sales, and other online content, including independent third-party verification of identification before entry and sale.

Taxation and Pricing

Restructure state excise taxation on adult-use cannabis to be proportional to the milligrams of THC in the taxed product, applicable to all cannabis products.

> Ensure that the restructuring maintains or increases cannabis tax revenue in line with the goals established by Assembly Bill 195 (Chapter 56, Statutes of 2022, a legislative commitment to replace revenue lost from the cultivation tax cut by 2026).

Prohibit discounting or promotion of flower >20% THC or other inhaled products over>35% THC.

Attractiveness to Children, Packaging, Labeling, and Consumer Information

Enforce existing laws and regulations that prohibit products that are attractive to children and restrict flavored additives in inhaled cannabis products.

Require plain packaging for all cannabis products with flower THC content above 20%, inhaled products exceeding 35% THC, and edibles containing more than 10 mg of THC per individual piece or liquid container, if permitted. Ideally, this should extend to all cannabis products.

Require clear standard information on the number of standard doses in a package on all cannabis and cannabis product packaging, based on a standard dose of 5 mg THC.

Strengthen regulations with clearer, evidence-based criteria for identifying and prohibiting products, packaging, marketing, and advertising characteristics that appeal to children and youth.

Require prominent, rotating, graphic front-of-pack health warning labels on cannabis products and on advertising, including specific warnings about high potency THC, such as risks of dependency and mental health harms. Health warnings should cover at least one-third of the front-of-pack and 15% of any print advertisement surface, with clear contrast between the warnings and the background.

> *Examples: "WARNING: Cannabis use may contribute to mental health problems, including serious mental health conditions. Risk is greatest for people who use frequently and when using products with high THC levels; "WARNING: The higher the THC content, the more likely you are to experience adverse effects and impairment. THC may cause severe anxiety and disrupt memory and concentration; "WARNING: Prolonged use of cannabis products high in THC may cause recurrent, severe nausea and vomiting."*

Adopt this Committee's recommendations for implementing SB540 requirements

Public Education

Fund and implement public education campaigns on the risks of high potency cannabis, including mental health risks. Allocate additional funds from Tier 3 of cannabis tax revenue (without reducing the Elevate Youth program) to the CDPH, totaling $10 million or more per year beyond their current allocation. These funds should be used to enhance high-quality cannabis prevention education campaigns, including those focused on high potency messaging, as well as supportive formative research and testing of messaging. Prioritize campaigns addressing use during pregnancy, drugged driving, and education for youth and seniors.

Compliance Screening, Data Collection, Research, and Evaluation

The Department of Cannabis Control and the state budget should allocate funds from the regulatory tier of taxation to establish a pre-market product and packaging review team. This team would screen new products for compliance with these recommendations (if accepted), existing regulations, and attractiveness to children. The team should also review all existing products within two years. Priority should be given to inhaled products with over 50% THC, followed by cannabis flower with over 20% THC, and edibles with more than one dose in a single container or physical piece.

Fund and ensure the tracking and regular reporting of negative health outcomes associated with high potency products in California hospitals, hospital emergency departments, and ambulatory care settings. Surveillance

systems should include the type and potency of marketed products as required data elements. Additionally, incentivize increased screening to more clearly document the product type used in clinical services and poison control cases.

The Administration and the DCC should support making the current Prop 64 requirement of at least $10 million in annual cannabis tax revenue for research an ongoing budgetary commitment. This funding should maintain a focus on research on health outcomes and policies related to cannabis potency. The requirement, currently set from 2018 to 2028, should be extended beyond 2028 and adjusted for inflation.

Provide additional funding in the 2024 budget to the University of California Office of the President to support scientific advice and testing related to the implementation of SB540. This funding should include support for developing additional warning messages, such as those regarding high potency, and for creating and evaluating SB540 retailer flyer language. Additionally, allocate funding for similar support every five years for re-evaluating messaging and message design, adjusted for inflation.

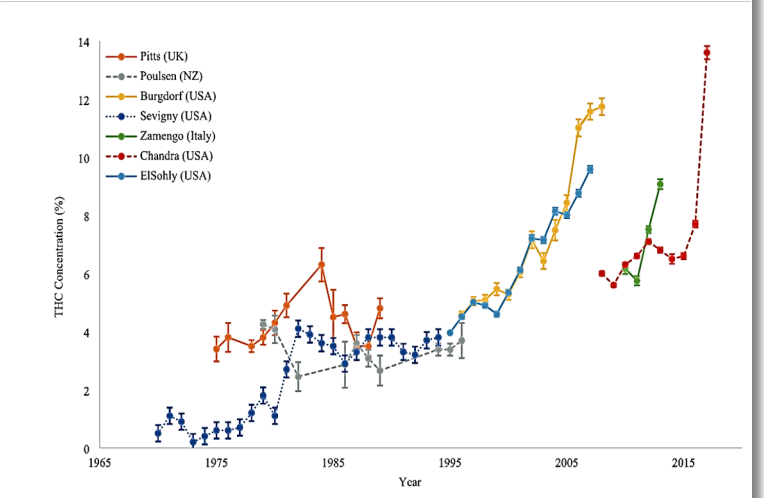
BACKGROUND

Cannabis potency is colloquially defined as the concentration (%) or dose (mg) of Δ9-tetrahydrocannabinol (THC) present in cannabis or cannabis products. THC is the primary psychoactive and intoxicating constituent of the cannabis plant. Since 1970, the potency of cannabis available in the United States has increased, which in turn increases the risk of adverse health outcomes for people who use cannabis. This report summarizes data on the increasing potency of cannabis, describes adverse outcomes from the use of high potency cannabis, and provides policy recommendations to reduce harm from the use of high potency cannabis.

California legalized medical cannabis in 1996, with successive decriminalization steps prior to full adult-use legalization in 2016 with the passage of Proposition 64. Adult-use commercial sales began in 2018. During those years, the U.S. and California cannabis markets changed dramatically. In the 1970s and 80s, the cannabis market was dominated by herbal cannabis with a THC content of 1.5% to 5%.[1] In recent decades, the herbal cannabis market has been profoundly transformed by the move to almost exclusive cultivation of "sinsemilla," flowers of the female plant, which are bred for higher THC content and replaced traditional low THC herbal cannabis.

Between 1970 and 2017, THC concentrations in herbal cannabis increased by 0.29% each year, (Figure 1) whereas in cannabis resin, THC concentrations increased twice as fast, by 0.57% each year (Figure 2).

Figure 1. *Mean (standard error) concentrations of delta-9-tetrahydrocannabinol (THC) in all herbal cannabis over time.*[4]

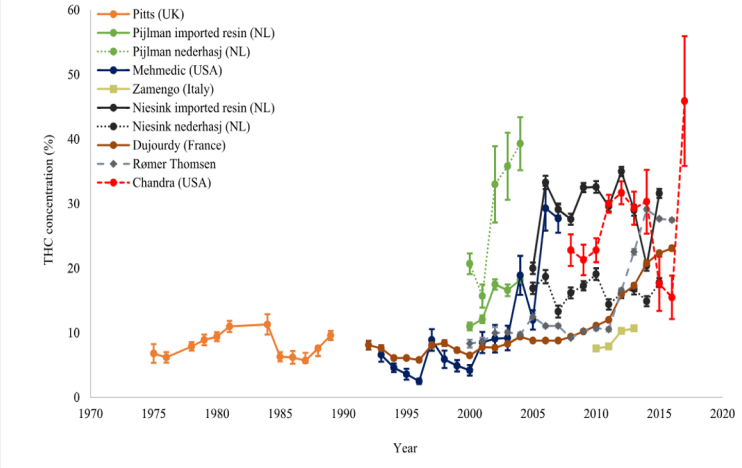


Reproduced from Freeman TP, Craft S, Wilson J, et al. Changes in delta-9-tetrahydrocannabinol (THC) and cannabidiol (CBD) concentrations in cannabis over time: systematic review and meta-analysis. Addiction.

Even the striking increases visible in global and national data through 2017 (Figures 1 and 2) do not capture the current California market trend, where average THC content of flower and concentrates or resins are now significantly higher. The 2024 study by Geweda et al,[2] randomly sampled and tested legal cannabis flower products in 4 states, with 68 California samples taken from San Diego and Central Valley retailers. Samples averaged 21% THC in San Diego and 24% THC in the Central Valley. Of the 68 California samples, only 23 were below 20% THC, and none were below 10% THC. Although most of the cannabis labels studied showed inflated THC levels (for example, only two of the 23 California samples below 20% THC were labeled as such), this study confirmed that values of THC exceeded by as much as ten-fold the strength of 1970s cannabis. Today, it is difficult to find traditional herbal cannabis below 10% THC at a California cannabis retailer. These more potent products lead to significant increases in THC exposure. One study found that the total amount of THC consumed in one episode of use of flower nearly doubled when using flower with 24% THC (58mg) relative to flower with 16% THC (30mg).[3] THC blood levels for both conditions were notably higher than those previously documented with lower potency flower.[3]

In contrast to THC, globally, cannabidiol (CBD), the main non-intoxicating cannabinoid content in herbal cannabis and cannabis resin did not change.[4] However, in U.S. markets specifically, CBD content in seized cannabis declined and remained low through at least 2017 before starting to rise[5,6]. Coupled with the rise in THC content in herbal cannabis samples from less than 1.5% in 1980 to 12% by 2012 in the U.S., [5,7] this has meant a larger increase in THC:CBD ratios in the U.S. marketplace, to the point where in the vast majority of commercial products CBD is present only in pharmacologically negligible amounts.

Figure 2. *Mean (standard error) concentrations of delta-9-tetrahydrocannabinol (THC) in cannabis resin over time.[4]*



Reproduced from Freeman TP, Craft S, Wilson J, et al. Changes in delta-9-tetrahydrocannabinol (THC) and cannabidiol (CBD) concentrations in cannabis over time: systematic review and meta-analysis. Addiction.

At the same time, the legal cannabis market diversified and began to mass-produce and intensively market a wide range of products, many of which did not exist before 2000. "Cannabis product" in California means cannabis that has undergone a process whereby the plant material has been transformed into a concentrate. This refers to edibles, vape oils, other concentrates, infused pre-rolls, and other products, whereas "cannabis" refers both to the entire market, and to herbal cannabis specifically. While mechanically extracted higher potency products such as hash oil had long been available, chemical extraction with butane and other solvents became routine. It led to the growth of the ultra-high potency manufactured products market (Figure 2). Generally, ultra-high potency in cannabis refers to very elevated concentrations of delta-9-tetrahydrocannabinol (for example 60-99% in cannabis products). Of concern, we are also now seeing the proliferation of illegal high potency products containing other psychoactive cannabinoids most often synthetically derived from CBD in hemp, such as delta-8 THC, Hexahydrocannabinol (HHC), and others.[8]

Marketed products now include a wide range of extracts meant to be used for inhalation that have a very high THC content, far beyond that naturally produced by the plant. The THC content of preloaded vaping cartridges, often marketed with flavors or with names or images explicitly or implicitly suggesting non-cannabis flavors, has gradually risen into the 80-90% THC range. These products are disproportionately purchased by youth[9] who value the ability to conceal them more easily and their ease of administration. Inhaling resins extracted from the cannabis plant with very high THC concentrations through "dabbing" is on the rise. These extracts come in various forms, such as *hash oil or honey oil*—a gooey liquid, *wax* or *budder*—a soft solid with a texture like lip balm, and *shatter*—a hard, amber-colored solid. While a decade ago, many concentrates were in the 50%THC range, today, many exceed 90% or even reach 99% THC. Dabbing typically provides a much higher dose per inhalation than smoking or vaping. For example, 90 mg THC was the typical ingestion in a study of people dabbing 70% and 90% THC concentrates, and blood levels were over twice those of the participants using herbal cannabis.[3] Many retailers sell pre-rolls of cannabis flower that are infused with THC concentrate, one of the market's fastest-growing segments.[10] This can typically drive potency of these products up to 45% THC.

The commercial edibles market has also expanded. While a couple of U.S. states started requiring demarcation with 5 mg THC single servings and with packages containing no more than 50 mg THC, most states, including California, have adopted policies mandating no more than 10 mg THC single serving demarcations and allowing up to 100 mg THC per package. Canada, on the other hand, does not allow more than 10mg in a full edible package. California's edible package limit is 10 times Canada's maximum package limit. California has also allowed products such as small beverage containers with 100 mg THC or a single scored cookie or bar with 100 mg THC, where demarcation is difficult to see.

An international group of scholars has proposed 5 mg of THC as a standard unit dose of cannabis to guide consumers and promote safer use, although people who use cannabis frequently prefer higher amounts.[11] NIH has also recommended 5 mg THC as a reference dose to improve the ability to interpret and compare research findings.[12] People who are inexperienced with cannabis are encouraged to start with lower doses. Canada is examining a standard reference dose which was also a recommendation of its five-year review process.[13] Typical starting medical doses are 2.1-2.5mg, the amounts in the FDA-approved medications Syndros and Marinol (range 2.5-10 mg).

Challenges for Research

Most research on the safety and health effects of cannabis does not fully reflect large-scale industrial diversification and market changes. While recent epidemiological studies on issues such as cannabis use disorder, daily or near daily use, emergency room visits, or unintentional ingestion or poisoning reports reflect real world use, experimental studies have mostly been limited to products obtained from sources authorized by the federal government, which have a far lower THC content and thus do not accurately reflect the range of products that are available on the market. For example, we searched the literature for experimental studies on dabbing and butane hash oil products but found only a few epidemiological surveys, case reports on toxicological effects, and non-placebo controlled naturalistic studies. Nevertheless, there is an emerging body of literature on the effects of higher potency THC, much of it focused on mental health effects and dependency.

Clinicians and scientists have called attention to the strong reasons for concern about this striking market trend for over 15 years, including in the National Academy of Science, Engineering and Medicine's (NASEM) landmark 2017 report on the health effects of cannabis. [14] The new 2024 NASEM report on the public health and equity consequences of cannabis policy notes that "*One of the most prominent public health concerns related to cannabis policy is the rise of high-concentration and high-potency THC products. The risks associated with THC consumption increase as the dose increases, and legalizing products that deliver high doses potentially increases adverse cannabis-related harms.* "[15]

Law and Regulation Treating All Cannabis "the same"

Despite these changes, our legal and regulatory systems – from the federal Controlled Substances Act of 1970 to local law – largely continue to treat all products derived from cannabis similarly – from the traditional herbal cannabis to 99% THC concentrates. Only some regulations speak to particular products by type (e.g. clean indoor air laws may treat smoked versus vaped or edible cannabis differently, and there are THC total mg limits for edible and concentrate packages). Irrespective of potency, manufacturers are typically permitted to launch whatever products they see fit within very broad guidance. Product characteristics associated with more harmful use, such as attractiveness to children, flavors known to appeal to youth, or

elevated potency, have not, to our knowledge, been prioritized for robust regulatory action or enforcement. By contrast, standards for contaminants were rapidly implemented and limited regulation of flavored additives was added in 2022 in California. Only a few states, such as Connecticut, Vermont, Colorado and a handful of California local governments, including Watsonville, Contra Costa County, Grass Valley, and Cathedral City, have sought to address the problem through tax structure, potency caps, product limits, plain packaging, or warnings.

Since the inception of California's regulatory process in 2017, public health and substance use disorder experts have consistently advocated for limits on potency, health warnings, and potency-based taxes in their formal comments, starting from the initial creation of the adult-use market and the first set of emergency regulations through each set of relevant rulemaking. For example, during the initial set of proposed emergency regulations for the launch of the adult-use market in December 2017, UCSF experts recommended a 100 mg THC per package limit on inhaled products, aligning with the limit for edibles. Another comment urged the prohibition of cannabis concentrates or products with over 50% THC content until a thorough risk assessment could be conducted through the normal regulatory process, noting that allowing "access to shatter with 90%+ THC is not an emergency." These concerns were not addressed in the final regulations, nor in subsequent rounds.

In 2019, Proposition 64 required California's Legislative Analyst's Office (LAO) to report with recommendations for adjusting the state's cannabis tax rate to achieve three goals: (1) undercutting illicit market prices, (2) generating sufficient revenue to fund the programs designated by the measure, and (3) discouraging youth use. Their recommendation was: "*We view reducing harmful use as the most compelling reason to levy an excise tax. Accordingly, we recommend that the Legislature replace the existing retail excise tax and cultivation tax with a potency-based or tiered ad valorem tax, as these taxes could reduce harmful use more effectively*" and "*Currently available information suggests that a potency-based tax in the range of $0.006 to $0.009 per milligram of THC could be appropriate*."[16] Cannabis tax reform in 2022 eliminated the cultivation tax but did not implement either of the LAO's recommended approaches to reduce harmful use.

No further regulatory action on these issues followed, as far as we know. Indeed, the California State Fair awarded a prize for the flower with the highest THC content despite public concerns.[17] In 2022, Senator Richard Pan introduced SB 1097, the Cannabis Right to Know Act, which would have mandated stronger, prominent graphic health warnings on packaging, including potency information, and provided consumers with additional information at the point of sale. However, the bill was stalled before the final vote. In the 2023 legislative session, Senator John Laird's SB 540 passed, requiring the development of point-of-sale information on safer cannabis use, including the risks associated with high potency products and the potential for THC to exacerbate certain mental health conditions, as well as a re-evaluation of current health warning labels.

In 2024, the State legislature approved a request for an audit of cannabis regulatory activities. While primarily focused on products attractive to children, part of the State Auditor's charge was to assess: *"What has DCC [Department of Cannabis Control] done to address the gradual rise of THC content in products which are associated with greater risk of dependency and psychosis for youth?"*

In summary, over the more than six years of California's legal adult-use commercial market, the trend toward higher potency has continued unabated, mirroring national trends. As in many other states, regulatory efforts have focused on establishing complex legal market structures rather than strengthening public health safeguards. As such, California's marketplace has become a leader in aggressively marketed products with very high THC content.

Intoxicating Hemp – Similar Hazards to High Potency Cannabis

While this report is focused on high potency cannabis in the adult-use cannabis market, regulated by the Department of Cannabis Control, the parallel emergence of a major intoxicating hemp market cannot be ignored. Until this month, edible hemp products with more Delta-9-THC then legal cannabis edibles could be legally sold to a 10-year-old in our state at any corner store. There is also a vast market of illegally sold inhalable and edible hemp products with high doses of psychoactive cannabinoids like Delta-8-THC, HHC and THC-P, synthetically derived from CBD in hemp. These often-high concentration products pose an immediate and urgent threat to children and youth and are now the route of initiation for a substantial part of teens using cannabis. [8,18] CDPH has authority to establish non-intoxicating content limits, as was originally the stated intent of the hemp market. Governor Newsom and CDPH issued emergency regulations to address this in September 2024; these regulations are an urgent priority for protecting youth.

Changing Patterns of Harmful Use

Teens and young adults below age 26 are generally considered to be at highest risk for adverse effects of cannabis. While overall cannabis use by teens has declined at the national level, frequency of use amongst teens who use cannabis rose by 26% nationally with onset of adult use retail sales.[19] Similarly, in California, while overall use rates among teens declined between 2015-2022, daily or near daily use has increased since legalization.[20]

Rates of past-year cannabis use in young adults – who are in a critical period when their brains are still developing – are particularly concerning. Nationally, use in the past 12 months has surged from 23.3% in 1991 to 42.4% in 2023 among adults ages 19-30 years. Daily use in this age group has quadrupled, rising from 2.4% in 1991 to 10.4% in 2023. In short, one in ten young American adults now use cannabis nearly every day. Additionally, among adults ages 35 to 50 years, past year and past month cannabis use more than doubled and daily use tripled from 2008 to 2023.[21]

Between 2008 and 2022, days of cannabis use increased 2.3 to 8.1 billion days per year. Whereas the 1992 National Survey on Drug Use and Health recorded 10 times as many people using alcohol daily or near daily relative to cannabis (8.9 vs. 0.9 million), by 2022, for the first time the number of people who use cannabis daily or near daily surpassed the number who use alcohol daily or near daily (17.7 vs. 14.7 million). While far more people drink, high-frequency drinking is less common. In 2022, the median drinker reported drinking on 4–5 days in the past month, versus 15–16 days in the past month for cannabis. In 2022, past-month cannabis consumers were almost four times as likely to report daily or near daily use (42.3% vs. 10.9%) and 7.4 times more likely to report daily use (28.2% vs. 3.8%) as alcohol consumers.[22]

Nationally, cannabis use during pregnancy – a period associated with particularly concerning risks – has more than doubled. From 2002-2003 to 2016-2017 national past-month cannabis use during pregnancy increased from 3.4% to 7.0% overall and from 5.7% to 12.1% during the first trimester. Past-month daily or near daily cannabis use during pregnancy tripled from 0.9% to 3.4% overall and quintupled from 0.5% to

2.5% during the third trimester.[23] In Northern California Kaiser Permanente patients the prevalence of prenatal cannabis use increased from 5.5% in 2012 to 9.0% in 2022, with striking differences in prevalence by age, race and ethnicity.[24,25]

Although many factors have changed, from social media to pandemics, striking trends of steadily increasing rates of frequent or problematic cannabis use among teens, young adults, older adults, and during pregnancy have occurred alongside the significant rise in cannabis potency.

It's Time to Revisit the Problem

On September 25, 2020, the Department of Cannabis Control's Cannabis Advisory Committee unanimously passed a resolution recommending that:

> *"[...]CDPH request and support the Office of the President of the University of California to convene an expert scientific task force, exempt from conflicts of interest, to review the scientific literature on the issue of increasingly high potency (THC content) of cannabis and cannabis products, the state of the science on health implications of increasing potency (for example, but without limitation, upon dependency, mental health, drugged driving, and health benefits), present a summary of the scientific data and make public health recommendations to cannabis regulatory agencies and to the public."* [26]

On September 18, 2022, California Governor Newsom issued a directive stating:

> *"To expedite policy reforms that prioritize and protect California consumers' health and safety, the Governor has directed the California Department of Public Health to convene subject matter experts to survey current scientific research and policy mechanisms to address the growing emergence of high-potency cannabis and hemp products"* [27]

During this period, the Newsom Administration, recognizing the growing crisis in youth mental health, its inequitable impacts on young people of color, LGBTQ+ youth and youth in under-resourced communities, also launched the Children and Youth Behavioral Health Initiative to meet the needs of kids and families, taking a "whole child" approach to address the factors that contribute to mental health and well-being of children and youth.

One factor likely contributing to the rising burden of mental health challenges among youth is cannabis use, particularly the growth in frequent use (20+ days per month) of high potency products. Improving cannabis policy offers a unique opportunity to reduce the incidence of preventable mental health issues triggered by cannabis in a modest but significant subset of young people who use it. This has the potential to reduce both serious harms to well-being, and significant preventable costs to families and government.

PROCESS

In the summer of 2023, as the COVID-19 pandemic began to wane, the California Department of Public Health (CDPH) Substance and Addiction Prevention Branch (SAPB) convened a multidisciplinary group of cannabis experts to review research on high potency cannabis. By December 2023, this group developed a plan to synthesize research on high potency cannabis and recommend policies to mitigate harm, particularly among youth, pregnant or breastfeeding individuals, and those vulnerable to psychosis or other

serious mental illnesses. The group selected Committee co-chairs, invited additional experts to fill gaps in representation, and chose a modified Delphi method[28] to develop their recommendations. The final Committee comprised 13 individuals with expertise in cannabis research, economics, health policy, public health, substance use disorder psychiatry, pediatrics, regulatory science, neuropsychopharmacology, pharmacology of substance use disorder, toxicology, health communication, and other relevant fields (see Appendix B). Two Committee scientists had been members of the National Academies of Science, Engineering and Medicine (NASEM) landmark 2017 review of the therapeutic and adverse Health Effects of Cannabis and Cannabinoids. Three are members of the current 2024 NASEM review of the Public Health Consequences of Changes in the Cannabis Policy Landscape, where leading scientists from around the world presented and an extensive review of relevant research was carried out. Their deep expertise from those experiences helped inform the group's work.

The Committee decided to prioritize addressing high potency in the adult-use cannabis market while indicating a willingness to explore issues related to the medical market in a separate report, and also recognized the problems posed by intoxicating hemp products.[29] Given that the majority of cannabis sales and usage are in the adult-use market, and most adverse outcomes are associated with adult-use cannabis, focusing on this area was deemed the most urgent starting point. Other states, such as Colorado and funded research groups were also reviewing the medical use issues, and the group did not wish to duplicate those efforts.

No funding was provided for the activities of the Committee, which worked in a volunteer capacity.

The Committee met approximately once a month from December 2023 through August 2024 via Zoom. The first step was to develop a working definition of high potency cannabis. The second step involved identifying health and intermediate outcomes that the proposed policies should aim to achieve. The group then created a 'library' of potential policies related to high-THC cannabis, drawing on recommendations from participating scientists, peer-reviewed publications, reports, professional experience, cannabis laws and policies from other U.S. states and countries, and regulatory science from other substances, particularly tobacco.

What is the Delphi Method?

Delphi is a research method designed to gather information from a group of experts to make decisions or develop recommendations. This approach is especially useful in cases in which the existing research is limited or emerging. This process involves eliciting expert input using a series of anonymous surveys, reporting the findings back to the group, and allowing experts the opportunity to adjust their input in response to that of their peers.

The modified Delphi process involved iterative rounds of quantitative and qualitative data collection. In Round 1, the focus was on assessing the expected impact on desired outcomes and feasibility, while Round 2 prioritized these findings and allowed for comments, suggestions, and additional proposals. Committee members provided input through an anonymous online survey. Twenty-one external scientific experts were invited by the Committee members to participate, and their feedback was reviewed in subsequent Committee meetings.

These meetings centered on discussing survey results and refining policy proposals. The iterative process facilitated interdisciplinary learning and refinement of the policies under consideration. The Committee used surveys and discussions to refine the working definition of high potency THC products, prioritize outcomes related to their use, and frame and contextualize policy recommendations.

While all Committee members contributed to the policy recommendations, this report represents a consensus statement reflecting what the members collectively agreed to put forward. Individual members may have had different preferences for specific details or priorities, so the recommendations represent the expertise of the Committee as a whole, rather than the views of any single member.

DEFINING THE PROBLEM: WHAT IS THE CHALLENGE OF HIGH POTENCY CANNABIS?

In defining the problem of 'high potency cannabis' and developing a policy approach, the Committee considered both dichotomous and continuous definitions. Each approach has benefits and drawbacks. A dichotomous approach would establish a specific threshold, above which cannabis is considered high potency and below which it is not. This type of definition may be easier to understand, communicate to the public, and apply in targeted policies.

***Table 2**. Dichotomous versus Continuous Approaches to the Problem of High potency Cannabis*

Dichotomous Approach	*Continuous Approach*
Easier to understand and communicate to the public	More challenging to understand and communicate to the public
Insufficiently captures drivers of THC intake in real-world cannabis use	Better reflects real-world cannabis use and how product design and use interact to impact total THC intake and adverse effects
Cutoffs capture only part of increased risk, since increases in risk begin at or below current market characteristics.	More consistent with the evidence

After thorough debate, the group concluded that limiting the discussion to a dichotomous definition of 'high potency cannabis' would oversimplify the issue. There is a pattern of increasing risk with increases in THC concentration, even at THC concentrations as low as 10% THC (and lower) in flower and with other higher potency products; risk rises in a dose-dependent manner. Currently, cannabis and cannabis products exceeding these levels, which are already far higher than the amount found in the cannabis available in the 1970s-1990s, now heavily dominate the California market, except for a small segment of CBD-predominant products. High levels of THC are present across various product types and modes of administration.

The proposed THC thresholds for certain policies in this report are not meant to imply that they represent any scientific consensus that these are safe cut-offs, nor do they constitute a definition of high potency cannabis.

As a society, we allowed these changes to unfold over time and are now grappling with the consequences. Addressing the adverse health outcomes associated with the shift in California's market toward high potency products requires a consumer-focused approach. The Committee recognized the need for a continuous approach to the issue of high potency and a holistic policy framework that encompasses, but is not limited to, policies targeting products above specific THC concentration or content thresholds. While these thresholds may capture some of the increased risk associated with high potency products, they represent a public policy compromise that addresses only part of the problem. Proposed THC thresholds for certain policies are based on a combination of considerations related to what we see in the California

market, what has been adopted as limits in other US states and by other countries with legal markets. They are not meant to imply that they represent any scientific consensus that these are safe cut-offs, nor do they constitute a definition of high potency cannabis.

Committee Problem Statement on High Potency in the Cannabis Market

- ❑ The higher the levels of THC in cannabis and cannabis products, the higher the risk of experiencing adverse events and cannabis use disorder. Adverse events may be immediate/acute or the result of longer-term or prolonged use.
- ❑ Adverse events are more common and can be more intense when the cannabis consumed contains 10% THC or more in inhaled products, or 10 mg THC or more in edible products. Risk is higher from products that deliver more than 10 mg THC in a single intake episode and increases as the amount of THC delivered rises.
- ❑ Frequent use, especially daily or near-daily consumption (20+ days per month), and binge consumption increase the risk of both acute adverse events as well as adverse events associated with prolonged use. These use patterns interact with potency to determine a person's cumulative THC exposure over a given period of time and overall risk of harm.
- ❑ Certain groups are particularly vulnerable to adverse effects: most notably those at a young age (26 years and under),[30] infants exposed during pregnancy, and those with a personal or family history of mental health conditions or substance use disorders.
- ❑ People who are inexperienced with cannabis may experience adverse effects even at low doses.

ADVERSE EFFECTS OF HIGH POTENCY CANNABIS

To understand the effects of high potency cannabis products, one must first consider the pattern of adverse effects of cannabis in general and of cannabis use disorder.

General Adverse Effects

- ❑ Acute effects while under the influence of cannabis include impaired learning and memory, disrupted executive function and perception (leading to problems with driving or operating equipment),[31,32] and, particularly among people who are inexperienced with cannabis, anxiety, and panic.[33,34]
- ❑ Relatively common adverse effects of frequent and prolonged cannabis use, even when people are not acutely intoxicated, include cannabis use disorder (evidencing symptoms such as using cannabis despite adverse consequences and physiological dependence) and, less frequently, severe nausea and vomiting (cannabis hyperemesis syndrome).[35,36] Although estimates are still being updated, most recent estimates show cannabis use disorder develops in roughly 20-25% of people who use cannabis, and in 45% of those who started using before age 16.[37] This transition rate is more than double what was observed two decades ago.[38]
- ❑ Other serious adverse effects, while less common, also have evidence of association with cannabis use. These include onset or worsening of or transition between psychosis and schizophrenia,[14,39–42] increased risk of car crashes,[14] increased risk of other mental illnesses, suicidal ideation and

attempts,[43,44] cardiovascular disease,[45] fertility problems in men and women[46,47] and, with smoking, respiratory disease.[14]

- ❑ Frequent cannabis use is also associated with poorer school performance,[48,49] higher unemployment,[49,50] and lower job income.[50,51]
- ❑ Cannabis use disorder is associated with higher rates of psychosis and schizophrenia,[52] mood disorders,[53,54] and cardiovascular disease.[55]
- ❑ The use of cannabis during pregnancy is associated with moderate increases in the risk of adverse neonatal health outcomes for the newborn including lower birthweight,[14] being small for gestational age, preterm birth, and neonatal intensive care unit admission.[56,57] It has also been associated with adverse maternal outcomes in California pregnancies including high blood pressure during pregnancy, preeclampsia, weight gain outside of the recommended ranges, and placental abruption.[58] Rates of daily use of cannabis during the year before pregnancy and during pregnancy have increased in recent years, are more common in pregnancies in younger individuals and those living in neighborhoods with greater deprivation and vary by race and ethnicity.[59] Most reports of use during pregnancy are in people who initiated use prior to pregnancy. Daily use during pregnancy in California increased faster than monthly or weekly use between 2009 to 2017.[59]
- ❑ Use during pregnancy may be associated with greater risk of long-term psychopathologies in children, including psychotic-like experiences and attentional problems, which have been documented over a decade after prenatal exposure, although findings are not consistent in all studies.[60–65]

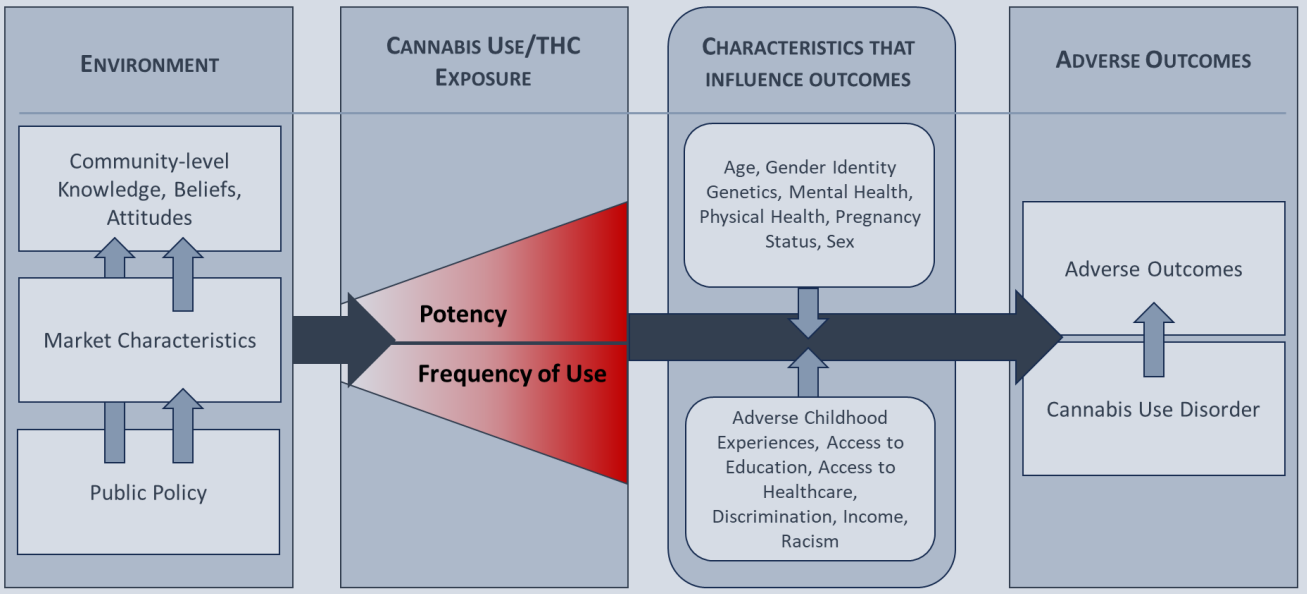
Specific Effects of High Potency Use

- ❑ Adverse effects are more likely to occur with the consumption of high potency products, especially when used frequently. High potency cannabis has been strongly associated with increased frequency of use, problematic use,[66] cannabis use disorder,[67] as well as with psychosis and schizophrenia.[68–70] The new 2024 NASEM report reinforces this conclusion.

> *"Indeed, high-concentration THC products are associated with a higher risk of psychosis and cannabis use disorder."*
>
> *National Academies of Science, Engineering and Medicine, 2024*

- ❑ The risk of progressing from cannabis initiation to cannabis use disorder increases with average potency available in the marketplace.[37]
- ❑ Long term-use of high potency products is associated with an increased severity of cannabis use disorder symptomology [71–74] and elevated risk of psychotic disorders.[41,75] Following a first-episode of psychosis, frequent use of high potency cannabis is associated with an increased risk of relapse, shorter latency to relapse, a greater number of relapses, and more intensive psychiatric care.[76] Exposure of populations to marketplace increases in THC concentrations are associated with a shorter latency to develop symptoms of problematic cannabis use[77] and increases in the treated incidence of both cannabis use disorders[78] and first-episode psychosis.[4,41]

Figure 3: *From Public Policy to Potency to Adverse Outcomes: A Conceptual Model*



THC content (potency) and frequency of use are crucial determinants of cannabis's impact on public health. Potency and frequency of use are influenced by **environmental factors**, such as the availability of high-potency products, marketing, and regulatory policies, and community knowledge and attitudes. **Individual characteristics** of people who use cannabis, including age and mental health status and **social determinants of health,** such as access to healthcare, adverse childhood experiences, and racism influence how potency and frequency of use affect adverse outcomes, and can also influence patterns of use. Cannabis use disorder, itself an adverse outcome, promotes a cycle of heavy use despite negative consequences, leading to further adverse outcomes.

Use of high potency cannabis increases risks both independently and in conjunction with factors such as frequency of use and individual vulnerabilities, including genetic predisposition to certain mental health conditions, as well as social determinants of health such as access to healthcare, adverse childhood experiences, and racism. By promoting more frequent and problem use, aggressive production and marketing of high potency products indirectly elevate the risk of other adverse effects by making it harder for individuals to moderate or cease use (Figure 3). Cannabis use disorder, itself an adverse outcome, promotes a cycle of heavy use, leading to further adverse outcomes.

Given the migration of the California market to high and very high potency cannabis, strategies to mitigate adverse health, educational, and social impacts must be holistic. These strategies should not only address the potency of the products themselves but also focus on increasing public awareness, promoting safer use, and reducing exposure to the highest-risk groups, such as adolescents and young adults, pregnant individuals, and those at risk of mental health conditions. A comprehensive strategy is essential to mitigate the risks associated with a high potency cannabis market.

DESIRED POLICY OUTCOMES

The group identified the following health outcomes as highest priority objectives for policies:

- ❑ Reduce the incidence of cannabis use disorder
- ❑ Reduce use and frequent use of cannabis by adolescents and youth under age 21
- ❑ Reduce cannabis-associated psychosis and psychotic disorders
- ❑ Reduce cannabis-associated emergency room visits
- ❑ Reduce cannabis use during pregnancy
- ❑ Reduce cannabis-impaired driving

Intermediate outcomes prioritized are:

- ❑ Increase public awareness of the hazards of high THC potency products and high THC intake
- ❑ Reduce sale and consumption of high THC potency products
- ❑ Increase availability of lower THC potency products

RECOMMENDED POLICIES TO REDUCE ADVERSE OUTCOMES FROM HIGH POTENCY CANNABIS

Given the factors that interact to create adverse outcomes from high potency cannabis, the Committee members have prioritized the following policies (Table 3) to reduce these adverse outcomes. The reader will note that there are different thresholds used as we suggest policy priorities. These thresholds, again, are not meant to imply that they constitute a "safe" cut-off below which there is no harm from excessive potency. Rather they are intended to reduce harms. There is a dose-response relationship between THC exposure and adverse health events, influenced by individual characteristics and history of use. As of our meeting, current science does not clearly identify specific thresholds (other than abstinence), below which there is no increased risk. Despite this limitation, we thought it was of great importance to propose thresholds with the potential to reduce harm based on observations of the California cannabis market vis-à-vis markets in other U.S. states, Canada, and Uruguay. These considerations seek to balance the benefits of a legal cannabis marketplace with preventing the harms to population health associated with unrestricted diversification of products driven by competition to sell a legal intoxicant. The recommendations considered most likely to have high impact are highlighted in green in Table 3 and presented in order in Table 4.

Table 3. *Recommended Public Policies for Reduction of Adverse Outcomes from High Potency Cannabis, by Category*

Recommended Policies to Reduce Adverse Health Outcomes Associated with High Potency Cannabis "Top ten" policies in terms of their likely impact are marked in green	
Marketing and Advertising	***Comments***
Prohibit cannabis and cannabis product advertising on billboards, and any other general public-facing advertising.	Billboard advertising directly reaches children, because a high percentage of the marketing is for high potency products, it markets these high potency products to children and youth. Billboard and other public-facing advertising that exposes children and youth to cannabis advertising is associated with youth cannabis use, including problem use. Research shows that frequent viewing of cannabis billboards by adolescents was associated with 6 times the odds of CUD. Rarely or sometimes viewing cannabis billboards by adolescents was associated with 5 times the odds of CUD compared to adolescents no billboard exposure.[79] Billboards and other public facing advertising should be fully prohibited. If allowed at all, it should be limited to where to obtain legal cannabis. 25 California jurisdictions prohibit cannabis billboards specifically or all billboards; 10 restrict cannabis billboards.
Restrict advertising of cannabis flower with over 20% THC or cannabis products with over 35% THC to simple plain text only.	Exposure to brand advertising of products and having a favorite brand is associated with a 3-fold increase in CUD and 8-fold increase in past year use among adolescents.[79] Liking or following a brand on social media is associated with a 5-fold increase in past year use by teens.[80] Advertising of these products can be made less appealing.
Product Requirements	***Comments***
Limit manufacture and sale of high THC products. Specifically: Prohibit the sale of liquid or solid concentrates for inhalation (e.g. dabs, wax, shatter) with THC content above 60% and implement careful oversight of allowable vehicles and diluents to ensure safety; Prohibit the sale of cannabis flower with THC content above 25% and prohibit the infusion of additional THC (or other psychoactive cannabinoids) into flower or pre-rolls; Limit edible products to a maximum of one 10 mg THC dose per physical piece or liquid beverage container (excluding tinctures).	***Concentrates:*** VT and CT have 60% limits on solid concentrates, budder, wax shatter, and resin. Quebec limits cannabis products to no more than 30% THC. Uruguay allows no edibles, vapes, oils, tinctures, or cannabis-infused products. In California currently there are products as high as 99% THC. ***Flower:*** VT and CT have 30% THC limits on flower. CA has no limit on flower, which can exceed 30% THC. Uruguay allows only plain flower sale, and limits flower to 15% THC. Germany prohibits flower above 10% for age 18-20. ***Edibles:*** CT, VT, and VA limit edibles to 5mg doses, and VT and VA limit packages to 50 mg. Canada limits edible packages to 10 mg. This would clarify for inexperienced edible consumers that taking more than 10 mg of an edible at once is not the norm. Currently there are 100 mg small beverage containers and bars.

Prohibit the use of added flavors (including fruits, mint, menthol, vanilla, chocolate, spices, and other common food flavors) in all inhaled products, whether natural or synthetic. Additionally, prohibit language and images that could lead consumers to believe the product has flavors other than those of cannabis. At a minimum, this should apply to flower or pre-rolls with THC content above 20% and other inhaled products with THC content above 35%.	For an extensive review of the science on how flavors attract youth and the role they have played in addicting youth see the FDA notice of proposed rulemaking for tobacco.[81] Watsonville and Contra Costa County prohibit flavored inhaled cannabis products. Canada has proposed regulations prohibiting flavored inhaled cannabis. CA prohibits flavored tobacco retail sales. Since nearly all manufactured inhaled products today are high potency, this will reduce their attractiveness to children and youth in particular. The Committee also recommends that strain names which include flavor references such as fruits may be provided on packaging in no larger than 6-point font (current font for health warnings) in an ingredients list located on side or back panels in black or white type. The current regulation on flavored additives in inhaled products should be strengthened and not weakened in any way (for example there should be no potency limit on current additive restrictions).
Retail Environment	***Comments***
Require retailers to offer lower dose options for flower (<10% THC) and edibles (5 mg or less), including products which are more suitable for medical use.	San Luis Obispo provides extra points to retailers who commit to stocking lower potency products. Canada's five-year evaluation report recommended "Distributors and retailers should stock cannabis products with diverse ranges of delta-9-tetrahydrocannabinol (THC) quantities or concentrations and take steps to encourage customers to choose lower-THC products whenever appropriate. "[13] The Swiss legalization pilot in Lausanne stocks 4 distinct potency ranges of flower coded with Greek letters for consumers.
Consider testing, promoting, or facilitating a Quebec-style public monopoly approach to cannabis sales, particularly in jurisdictions that have not yet legalized cannabis sales.	Use of a public monopoly approach has been recommended by experts as the policy most likely to be effective to reduce youth use of cannabis, excessive cannabis use among the general population, and cannabis-impaired driving.[82] Four Canadian provinces have variations of this policy, with Quebec being the strongest. Numerous US states still use state alcohol store approaches, which have been effective in reducing harmful alcohol use. Quebec has seen positive results, with successful legal market transition, high public satisfaction and profitable operations with lower increases in consumption than other provinces. This approach was highlighted in the 2024 NASEM report.
Require more robust age-gating for websites, online sales, and other online content, including independent third-party verification of identification before entry and sale.	Current requirements are weak and easily and widely circumvented.[83]

Taxation and Pricing	*Comments*
Restructure state excise taxation on adult-use cannabis to be proportional to the milligrams of THC in the taxed product, applicable to all cannabis products. Ensure that the restructuring maintains or increases cannabis tax revenue in line with the goals established by Assembly Bill 195 (the 2022-2023 legislative commitment to replace revenue lost from the cultivation tax cut by 2026).	This recommendation is consistent with that of the California Legislative Analyst's office. Used successfully by CT, IL, and Canada. CT requires retailers to pay a potency excise tax. The tax rates are $0.00625 per mg of total THC in flower; $0.0275 per mg of total THC in edibles; and $0.009 per mg of total THC in other cannabis products. IL has a cannabis potency tax of 10% of the purchase price for cannabis with Delta-9 THC levels at or below 35% and 25% of the purchase price for cannabis with Delta-9 THC levels above 35%. NY tax (repealed): Cannabis flower at 0.5 cents per mg of total THC; concentrated cannabis at 0.8 cents per mg of total THC; and cannabis edible products at 3 cents per mg of total THC. The California Legislative Analyst's Office recommended: *Currently available information suggests that a potency-based tax in the range of $0.006 to $0.009 per milligram of THC could be appropriate.*[16] The City of Grass Valley taxes potency as *"an additional tax of up to 1% of the gross receipts from high potency cannabis and each high potency cannabis product cultivated, manufactured or sold by the taxpayer, multiplied by the percent of the THC content above 17%; and an additional tax of 20% of gross receipts from sweetened cannabis beverages." Cathedral City also has a tax that varies by product type.* Canada's five-year review of cannabis legalization recommended maintaining and strengthening its THC based tax.[13]
Prohibit discounting or promotion of flower >20% THC or other inhaled products over>35% THC.	Restrictions on discounting and promotions have been widely and successfully used in tobacco control as these discounts increase youth purchasing.[84,85] They are part of the global Framework Convention on Tobacco Control. Pasadena and three other CA cities use them for cannabis. This would focus a statewide restriction on higher potency products.
Attractiveness to Children, Packaging, Labeling, and Consumer Information	***Comments***
Enforce existing laws and regulations that prohibit products that are attractive to children and restrict flavored additives in inhaled cannabis products.	This will greatly assist in reducing use by the group most vulnerable to high potency products: children and youth. CA issued a limited prohibition addressing flavored additives in inhaled cannabis in 2022, yet these products remain widely available.
Require plain packaging for all cannabis products with flower THC content above 20%, inhaled products exceeding 35% THC, and edibles containing more than 10 mg of THC per individual piece or liquid container, if permitted. Ideally, this should extend to all cannabis products.	This practice is in use in several states, including CT, MO, MA and NJ.[86] MO is requiring pre-approval of packaging/labeling. This practice has also been in use in Canada since legalization. A recent 5-year review of Canada's legalization recommended maintaining plain packaging.[13]

	A recent study supported the effectiveness of this approach for cannabis.[87]
Require clear standard information on the number of standard doses in a package on all cannabis and cannabis product packaging, based on a standard dose of 5 mg THC.	NIH has recommended use of the 5 mg standard dose and Canada is examining it.[11–13]
Strengthen regulations with clearer, evidence-based criteria for identifying and prohibiting products, packaging, marketing, and advertising characteristics that appeal to children and youth.	These include, for example, use of illustration including cartoons, animals/creatures, food and flavors terms and images, discounts or bonuses, distinctive colors and shapes (especially red, orange, yellow, or green in edibles), positive sensations, psychoactive appeals, action/adventure, brand sponsorships of sports and entertainment events or other social or cultural events.[88–92] While CA State law and regulation establish some criteria, they are insufficient and less stringent than several other states.
Require prominent, rotating, graphic front-of-package health warning labels on cannabis products and on advertising, including specific warnings about high potency THC, such as risks of dependency and mental health harms. Health warnings should cover at least one-third of the front-of-package and 15% of any print advertisement surface, with clear contrast between the warnings and the background. *Examples: "WARNING: Cannabis use may contribute to mental health problems, including serious mental health conditions. Risk is greatest for people who use frequently and when using products with high THC levels; "WARNING: The higher the THC content, the more likely you are to experience adverse effects and impairment. THC may cause severe anxiety and disrupt memory and concentration; "WARNING: Prolonged use of cannabis products high in THC may cause recurrent, severe nausea and vomiting."*	FDA is moving to require graphic front of pack warnings on tobacco based on extensive research. Many countries have adopted this approach for tobacco products. Canada requires strong front-of-package rotating warnings with a contrasting yellow background on all cannabis. They are in the process of updating their warnings including those related to psychosis and mental health. Research testing potential cannabis labeling options have found prominent graphic rotating warnings to be effective and the psychosis warning to be particularly valuable for youth.[93–97]
Adopt this Committee's recommendations for implementing SB540 requirements	See section on SB540.
Public Education	***Comments***
Fund and implement public education campaigns on the risks of high potency cannabis, including mental health risks. Allocate additional funds from Tier 3 of cannabis tax revenue (without reducing the Elevate Youth program) to the CDPH, totaling $10 million or more per year beyond their current allocation. These funds should be used to enhance high-quality cannabis prevention education campaigns, including those focused on high potency messaging, as well as supportive	Public education campaigns are a best practice for tobacco control which are readily adaptable to cannabis. Effective public education campaigns are those that reach at least 75% of the intended audience in each quarter of the year,[98] are well-liked within the intended audience and do not perpetuate stigma,[99,100] feature messages that are statistically associated with beliefs and behaviors the campaign seeks to change,[101] and seek to influence beliefs and behaviors that have "room to move."

formative research and testing of messaging. Prioritize campaigns addressing use during pregnancy, drugged driving, and education for youth and seniors.	
Compliance Screening, Data Collection, Research, and Evaluation	***Comments***
The Department of Cannabis Control and the state budget should allocate funds from the regulatory tier of taxation to establish a pre-market product and packaging review team. This team would screen new products for compliance with these recommendations (if accepted), existing regulations, and attractiveness to children. The team should also review all existing products within two years. Priority should be given to inhaled products with over 50% THC, followed by cannabis flower with over 20% THC, and edibles with more than one dose in a single container or physical piece.	This approach can preventively reduce noncompliant products marketed and improve the safety of the legal market. MA and Canada use this approach. MD reviewed medical products for compliance. MO is adopting pre-market review of packaging.
Fund and ensure the tracking and regular reporting of negative health outcomes associated with high potency products in California hospitals, hospital emergency departments, and ambulatory care settings. Surveillance systems should include the type and potency of marketed products as required data elements. Additionally, incentivize increased screening to more clearly document the product type used in clinical services and poison control cases.	Current budgetary allocations support CDPH epidemiologic surveillance of legalization impacts. This important effort needs to be adequately funded and deepened to carefully examine mental health and other impacts, and also not to compete with CDPH spending on public education, which needs its own strong allocation.
The Administration and the DCC should support making the current Prop 64 requirement of at least $10 million in annual cannabis tax revenue for research an ongoing budgetary commitment. This funding should maintain a focus on research on health outcomes and policies related to cannabis potency. The requirement, currently set from 2018 to 2028, should be extended beyond 2028 and adjusted for inflation.	While this recommendation was rated as highly impactful, the authors excluded it from Table 4 due to the potential perception of a conflict of interest of Committee members.
Provide additional funding in the 2024 budget to the University of California Office of the President to support scientific advice and testing related to the implementation of SB540. This funding should include support for developing additional warning messages, such as those regarding high potency, and for creating and evaluating SB540 retailer flyer language. Additionally, allocate funding for similar support every five years for re-evaluating messaging and message design, adjusted for inflation.	Best practices for the design of warning labels and public education materials and campaigns include testing materials with consumers for effectiveness. Canada carried out focus group research for its health warning labels and is doing so again this year.

Table 4. *Top Ten Recommended Policies by Likely Greatest Impact on Adverse Outcomes, in Order*

Top Ten Recommended Policies by Likely Greatest Impact on Adverse Outcomes, in Order
Prohibit cannabis product advertising on billboards, or any other general public-facing advertising
Limit manufacture and sale of high THC products. Specifically a) prohibit the sale of liquid and solid concentrates for inhalation (e.g. dabs, wax, shatter) with THC content above 60% and implement careful oversight of allowable vehicles and diluents to ensure safety; b) Prohibit the sale of cannabis flower with THC content above 25% and prohibit the infusion of additional THC (or other psychoactive cannabinoids) into flower or pre-rolls; and c) Limit edible products to a maximum of one 10 mg THC dose per physical piece or liquid beverage container (excluding tinctures).
Consider testing, promoting, or facilitating a Quebec-style public monopoly approach to cannabis sales, particularly in jurisdictions that have not yet legalized cannabis sales.
Restructure state excise taxation on adult-use cannabis to be proportional to the milligrams of THC in the taxed product, applicable to all cannabis products. Ensure that the restructuring maintains or increases cannabis tax revenue in line with the goals established by Assembly Bill 195 (the 2022-2023 legislative commitment to replace revenue lost from the cultivation tax cut by 2026).
Enforce existing laws and regulations that prohibit products that are attractive to children and restrict flavored additives in inhaled cannabis products.
Prohibit the use of added flavors (including fruits, mint, menthol, vanilla, chocolate, spices, and other common food flavors) in inhaled products, whether natural or synthetic. Additionally, prohibit language and images that could lead consumers to believe the product has flavors other than those of cannabis.
Strengthen regulations with clearer, evidence-based criteria for identifying and prohibiting packaging, marketing, and advertising characteristics that appeal to children and youth.
Fund and implement public education campaigns on the risks of high potency cannabis, including mental health risks. Allocate additional funds from Tier 3 of cannabis tax revenue (without reducing the Elevate Youth program) to the CDPH, totaling $10 million or more per year beyond their current allocation. These funds should be used to enhance high-quality cannabis prevention education campaigns, including those focused on high potency messaging, as well as supportive formative research and testing of messaging. Prioritize campaigns addressing use during pregnancy, drugged driving, and education for youth and seniors.
Fund and ensure the tracking and regular reporting of negative health outcomes associated with high potency products in California hospitals, emergency rooms, and ambulatory care settings. This should include documenting the type and potency of marketed products. Additionally, incentivize increased screening to more clearly document the product type used in clinical services and poison control cases.
Require plain packaging for all cannabis products. At a minimum, this should apply to high potency products, including flower with THC content above 20%, inhaled products exceeding 35% THC, and edibles containing more than 10 mg of THC per individual piece or liquid container, if permitted.

INPUT ON INFORMATION TO CONSUMERS FOR SB540 IMPLEMENTATION

In 2023 the California state legislature passed SB 540 (Senator Laird) after a previous similar effort through SB 1097 (Senator Pan) in 2022. The bill added language to the Medicinal and Adult-Use Cannabis Regulation and Safety Act (MAUCRSA). It created critically important and legislatively mandated opportunities to address risks from high potency cannabis through two consumer information strategies – a required brochure at point of sale and mandated reassessment of health warnings on packaging every 5 years.

The bill, by January 1, 2025, requires the DCC, in consultation with the State Department of Public Health, to create and post for public use a single-page flat or folded brochure that includes steps for safer use of cannabis, including, but not limited to, both of the following:

A) Information about the pharmacological effects of cannabis use.

B) Information on the implications and risks associated with, but not limited to, all of the following:

   i) High potency cannabis products.
   ii) The potential for THC to exacerbate certain mental health conditions.
   iii) Cannabis use by minors.
   iv) Cannabis use by pregnant and breastfeeding persons.

The bill, by March 1, 2025, requires a retailer or microbusiness selling, or person delivering, cannabis or cannabis products to a consumer to:

- ❑ Prominently display the brochure, including printed copies, at the point of sale or final delivery in person or online
- ❑ Offer each new customer a copy of the brochure at the time of first purchase or delivery.

The bill, by January 1, 2030, and every 5 years thereafter, requires the department to either recertify the information in the brochure or provide updated language, as specified.

The California Department of Public Health requested support from the Committee to propose language to inform consumers in compliance with this legislative mandate for point-of-sale information, particularly in regard to high potency. The group developed the following model trifold brochure as our recommendation to the State agencies. It is based on the current state of the science on cannabis risks and publications such as the lower risk cannabis use guidelines,[102] as well as on expertise in developing effective public education campaigns on health issues and health literacy.

***Figure 4**: Committee Recommendations for the SB540 Point-of-Sale Brochure*

Current state law also requires cannabis and cannabis product labels and inserts to include specified warnings about the safety of cannabis use that were defined in the 2016 ballot initiative. This is currently a long sentence typically printed in 6-point font (cannot be smaller), without requirements for contrast or illustrations, on the back or sides of products, or in some cases on inserts or peel off labels, in even less prominent locations.

SB540 requires DCC, on or before July 1, 2025, to reevaluate regulations for the above-described warnings to determine whether any additional warnings are necessary to reflect evolving science and would require the department to adopt regulations for cannabis and cannabis product labels or inserts reflecting the evolving science regarding the risks that cannabis use may pose for consumers.

The bill also requires that by January 1, 2030, and every 5 years thereafter, DCC to reevaluate the adopted regulations to determine whether the requirements reflect the state of the evolving science on cannabis health effects and on effective communication of health warnings.

The Committee worked to include recommendations regarding health warnings and the research needed to inform their reassessment to assist in compliance with this important new legal mandate. (Table 2) Recommendations also include funding recommendations for evaluation of the brochure and for formulating best health warnings, which was also recommended in the legislation. Budgeting for cannabis policy research is already part of required state spending of cannabis tax revenues, at least through 2028 and the group recommends maintaining that allocation indefinitely. Updating of warning labels every 5 years to reflect current science is one important reason to fund ongoing cannabis policy research.

SUPPORT FOR RESEARCH AND EVALUATION

These policy recommendations were made with the best available scientific evidence. However, as is often the case in the development of public health policy, much remains to be learned about the health and social impact of using high potency cannabis, and about the effectiveness of the proposed policies to address it. **Ongoing research is important to further clarify associations of potency with problem use, mental health effects and other adverse or positive outcomes.** Our review demonstrates that further research, especially using more standard exposure measures and longitudinal designs to further test and strengthen the evidence of associations is urgently needed.

Therefore, the Committee recommends funding be allocated for research and evaluation in this topic area. Specifically, research is needed to better understand what populations are susceptible to adverse mental health effects of high potency cannabis; what messages will be most effective in preventing or reducing use of high potency cannabis among susceptible populations, including youth, people who are pregnant or breastfeeding, and people with preexisting mental health conditions; whether taxes and other incentives can reduce the mean level of THC available for sale in California; whether product limits reduce adverse outcomes, whether packaging and labeling requirements can result in more THC-informed consumers. The Committee recommends that CDPH evaluate the effectiveness of any high potency THC policies implemented as a result of this process, to document outcomes as a model for other states and the federal government, and so adjustments can be made to local, state and Federal policies if necessary to increase effectiveness.

CONCLUSION

The consensus of this Committee is that the potency (i.e., the concentration of delta-9 THC) contained in the cannabis plant, as well as products derived from it, is substantially higher today than it has been historically and far exceeds levels typically studied in carefully designed scientific trials. In California today, which has had a medical market since 1996, the average potency of herbal cannabis sold is significantly higher than that sold in most state markets as well as those of other countries. California's marketplace also offers a variety of cannabis products which deliver doses of THC that far exceed that which can be obtained through vaping or smoking the plant itself.

In December 2023, this Committee developed a plan to synthesize research on high potency cannabis and recommend policies to mitigate the health harms associated with its use, particularly among youth, pregnant or breastfeeding individuals, and those vulnerable to psychosis or other mental health conditions.

"Given the expansive migration of the California market to high and very high potency cannabis, the Committee concluded that strategies to mitigate adverse health, educational, and social impacts are urgently needed and must be holistic. These strategies should not only address the potency of the products themselves but also focus on increasing public awareness, promoting safer use, and reducing exposure to the highest-risk groups."

The Committee concluded that health risks, regardless of population being studied, are likely to rise in a dose-response fashion with use of higher potency cannabis. We also recognize that age, experience with the product, pregnancy, risk of mental illness, and other individual and social factors influence the likelihood of adverse outcomes. While we did not conclude that a specific threshold defines high potency cannabis, below which use is "safe," we did identify potential policies that can reduce harm from higher potency products. Developing guidelines to help moderate those risks, in light of the availability of the wide array of cannabis products containing historically large amounts of THC in the California marketplace, is prudent given the existing scientific evidence of adverse health effects associated with frequent and prolonged use of cannabis generally. High potency cannabis increases risks both independently and by increasing frequent use and cannabis use disorder. Increases in risk from high potency cannabis are influenced by factors such as frequency of use and individual vulnerabilities, including genetic predisposition to certain serious mental illnesses.

Given the expansive migration of the California market to high and very high potency cannabis, the Committee concluded that strategies to mitigate adverse health, educational, and social impacts are urgently needed and must be holistic. These strategies should not only address the potency of the products themselves but also focus on increasing public awareness, promoting safer use, and reducing exposure within the highest-risk groups. As the Committee closed its work, we were pleased to see that this approach is consistent with that advised in the newly issued 2024 NASEM report, which calls for definition of best practices that encompass marketing restrictions (e.g., on advertising and packing), age restrictions, physical retail and retail operating restrictions, taxation, price restrictions, product design, and measures to limit youth access.

Noting this need for a holistic approach to mitigate risk, and the widely held belief from this Committee of experts and others that there is likely to be a dose-response relationship between exposure to THC and adverse health events, mediated by individual characteristics and history of use, the members of this group first generated a broad list of policy recommendations aimed at trying to minimize the marketing and packaging appeal of higher potency cannabis products especially among youth, reduce the amount of THC currently contained with these products, limit the availability of particularly high potency products, increase the relative price of these goods through potency-based taxation, and increase consumer awareness of the risks associated with their use. Through a modified Delphi-process we then ranked which of these were likely to have the highest impact on adverse health consequences, drawing on our knowledge of the current state of the cannabis science as well as our understanding of the effectiveness of similar strategies at reducing heavy drinking and cigarette smoking. The highest ranking strategies included prohibitions on billboards and other public facing advertisement; limits on the manufacture and sale of high THC products similar to those adopted in Connecticut and Vermont, the adoption of a public monopoly model (which may still be useful in the large parts of the state which have not yet licensed retailers); taxing cannabis based on THC content rather than weight; enforcing existing laws and regulations that prohibit the development of products that appeal to children and youth, especially those including flavored additives; strengthening the prohibition on added flavor or flavor marketing in inhaled products; strengthening regulations on packaging and advertisement that appeals to youth; funding a comprehensive public health campaign focused on the risks of high potency cannabis specifically; conducting surveillance of health outcomes tied to the potency of cannabis products; and requiring plain packaging of cannabis products with historically high levels of THC.

In response to a request by the California Department of Public Health, as part of their collaboration with the Department of Cannabis Control in implementing new legislatively required public awareness messaging on high potency cannabis (SB540), we also generated a Point-of-Sale Brochure highlighting various tips to help educate the public about cannabis use, higher potency, and simple steps to have a safer (and more enjoyable) experience with cannabis if they opt to use it.

We appreciate the opportunity to share these thoughts and recommendations with the California Department of Public Health and its colleagues across state government, as we understand the difficulty of identifying evidence-based policies in the setting of a rapidly changing market where today's products are substantially changed from those studied in past research.

Choosing not to act on high potency cannabis is as much a policy choice as implementing new policies, and one with significant negative implications for mental health, substance abuse, and other areas. It is time to change course and acknowledge that not all that can be derived from cannabis should be treated as safe consumer products. As a state, we have an interest in building a safer legal cannabis market for the long-term; one in which educated consumers can have greater confidence, and which provides legal access to products, packaging, and marketing less likely to induce harmful patterns of use, cannabis use disorder, or other harms.

We extend these recommendations to our Governor and to the relevant policymaking and public health bodies of our state, including the State Legislature, the Department of Cannabis Control, The California Department of Public Health, the broader Department of Health and Human Services, the Department of Tax and Finance Administration, the State Auditor and the Department of Justice. We urge the State of California, with all its components, to work together to pass and implement these policies.

APPENDIX: COMMITTEE MEMBERS

Jane Appleyard Allen, MA (Co-Chair), Jane Appleyard Allen is a Senior Scientist in the Center for Communication and Media Impact at RTI International. She has 25 years of experience evaluating state and national public education campaigns, conducting formative research for campaign message development, and conducting research to understand consumer perceptions of cannabis and tobacco products and policies. Ms. Allen's media campaign experience includes Colorado's Retail Marijuana Education Program, FDA's The Real Cost campaign, the national truth campaign, and the National Youth Anti-drug Media Campaign. In collaboration with RTI's Racial Justice and Equity Program and RTI's Black Employee Resource Group, Ms. Allen facilitates trainings that prepare participants to understand and work effectively to dismantle anti-Black systemic racism.

Neal Benowitz, MD, Professor Emeritus of Medicine University of California San Francisco School of Medicine, Cardiologist, Clinical Pharmacologist, Medical Toxicologist, Expert in pharmacology and toxicology of nicotine and of cannabis, Past President of the American Society for Clinical Pharmacology and Therapeutics.

Ricky Bluthenthal, PhD, Distinguished Professor of Population and Public Health Science, Associate Dean for Social Justice, Interim Chair, Department of Population and Public Health Science, University of Southern California Keck School of Medicine, Sociologist, substance abuse and HIV researcher.

Beatriz H. Carlini, PhD, MPH. Research Associate Professor, Addictions, Drug & Alcohol Institute, Department of Psychiatry & Behavioral Sciences, University of Washington School of Medicine**.** Director, Cannabis Education & Research Program (CERP). Social psychologist who has studied public health impact of legal psychoactive substance use and policies on social and health outcomes. In 2020, she chaired the WA Prevention Research Subcommittee Cannabis Concentration Workgroup, which authored a Consensus Statement and Report on Cannabis Concentration and Health Risks. In 2021-22, Dr. Carlini and team led development of policy recommendations for the WA State Health Care Authority related to cannabis concentration and mitigating detrimental health impacts, resulting in a report to WA Legislature in 2022.

Ziva Cooper, PhD, Director of the University of California Los Angeles Center for Cannabis and Cannabinoids in the Jane and Terry Semel Institute for Neuroscience and Human Behavior and Professor in the UCLA Departments of Psychiatry and Biobehavioral Sciences and Anesthesiology. Dr. Cooper served as a member of the National Academies of Science Engineering and Medicine 2017 review of the Health Effects of Cannabis and Cannabinoids, and on their 2024 committee on the Public Health Consequences of Changes in the Cannabis Policy Landscape, as President of the International Cannabinoid Research Society, a past Board Director for the College on Problems of Drug Dependence, an Associate Editor of Neuropsychopharmacology, and as an editorial board member for several journals including American Journal of Drug and Alcohol Dependence and Cannabis and Cannabinoid Research.

Timothy Fong, MD, Professor of Psychiatry, board certified in Addiction Psychiatry, at the Semel Institute for Neuroscience and Human Behavior at the University of California Los Angeles and the UCLA Brain Institute. He directs the UCLA Addiction Psychiatry Fellowship and is part of the faculty leadership of the UCLA Center for Cannabis and Cannabinoids.

Bonne Halpern-Felsher, PhD is Marron and Mary Elizabeth Kendrick Professor in Pediatrics, Taube Endowed Research Faculty Scholar and Professor (by courtesy), Epidemiology & Population Health; Psychiatry & Behavioral Sciences at the Stanford University School of Medicine. She is founder and Director of the REACH Lab in the Division of Adolescent Medicine, Department of Pediatrics, Stanford University. Dr. Halpern-Felsher is a developmental psychologist with extensive experience in tobacco research and regulation, and more recently, cannabis. She recently joined the California Department of Cannabis Control's Cannabis Advisory Committee.

Renee M. Johnson, PhD, MPH is Professor & Vice Chair for DEI in the Department of Mental Health at the Johns Hopkins Bloomberg School of Public Health. Her research addresses substance use, overdose prevention, injury and violence, adolescent/emerging adult health, and health equity. uses social epidemiology and behavioral science methods to investigate injury/violence, substance use, and overdose prevention. Dr. Johnson co-leads the Drug Dependence Epidemiology Training Program.

Pamela Ling, MD, MPH, Professor of Medicine at the University of California San Francisco School of Medicine. Dr. Ling directs the UCSF Center for Tobacco Control Research and Education and has extensive experience in a broad range of tobacco and cannabis research, including product marketing and promotion, industry strategies, consumer perceptions, young adult tobacco and cannabis use and co-use behavior, and prevention, cessation and policy interventions.

Rosalie Liccardo Pacula, PhD, Professor and Elizabeth Garrett Endowed Chair in Health Policy, Economics and Law, and Chair of the Health Policy and Management Department within the Price School of Public Policy at the University of Southern California. Dr. Pacula is an economist and expert in the economics of addiction and related policy. She served on NIDA's National Advisory Council Cannabis Policy, the Substance Abuse and Mental Health Services Administration (SAMHSA's) technical advisory committee on preventing cannabis use among youth, the World Health Organization's Technical Expert Committee on Cannabis Use and Cannabis Policy, and as Past President of the International Society for the Study of Drug Policy. She currently serves as Co-Chair of the National Academies of Sciences, Engineering and Medicine's (NASEM's) Forum on Mental Health and Substance Use Disorders and was part of the 2024 NASEM Committee on the Public Health Consequences of Changes in the Cannabis Policy Landscape.

Daniele Piomelli, PhD, is Distinguished Professor, Anatomy & Neurobiology at the University of California Irvine School of Medicine, Louise Turner Arnold Chair in Neurosciences, holds a Joint Appointment in Biological Chemistry. Dr. Piomelli is the Director of the Center for the Study of Cannabis and Editor-in-Chief of Cannabis and Cannabinoid Research. He is a pharmacologist and neuroscientist with extensive research in schizophrenia and depression as well as cannabinoid basic science. He was a member of the National Academies of Science Engineering and Medicine 2017 review of the Health Effects of Cannabis and Cannabinoids.

Lynn D. Silver, MD, MPH (Co-Chair), Senior Advisor at the Public Health Institute, Director of the Prevention Policy Group and of Getting it Right from the Start at PHI, a national cannabis policy initiative which developed the first public health-oriented model laws for cannabis retailing, marketing and taxation. She is Clinical Professor of Epidemiology and Biostatistics and the University of California San Francisco School of Medicine and served on the Proposition 64 Stakeholder Advisory Committee for the State of California Department of Health Care Services. Dr. Silver is board certified in pediatrics and has extensive experience as a public health official. Her current research is primarily in the areas of cannabis policy and health effects,

food taxation and other public health regulatory and funding policies. She has served as consultant to the World Health Organization, the World Bank, and the Campaign for Tobacco Free Kids on policies for prevention of noncommunicable disease.

Kelly C. Young-Wolff, PhD, is a clinical psychologist and research scientist at the Kaiser Permanente Northern California Division of Research, Adjunct Associate Professor in the Department of Psychiatry, University of California, San Francisco; Adjunct Lecturer in Medicine at the Stanford University School of Medicine; and Professor, Kaiser Permanente Bernard J. Tyson School of Medicine. Dr. Young-Wolff's research focuses on substance use, among vulnerable populations, including pregnant persons and adolescents, and evaluates the impact of changes in local, state, and national drug policies. She serves on the 2024 National Academies of Sciences, Engineering, and Medicine's committee on the Public Health Consequences of Changes in the Cannabis Policy Landscape. Dr. Young-Wolff's also conducts research on intimate partner violence and adverse childhood experiences (ACEs) and serves on the California Surgeon General's ACEs Aware Evaluation and Evidence Advisory Committee.

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