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Cannabis Policy in the United States: Implications for Public Health

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This manuscript was submitted before legalization of adult use cannabis in New York State (March 2021), Virginia (April 2021), New Mexico (April 2021), and Connecticut (June 2021).

Abstract

Abstract Introduction As of January 2021, a total of 36 states and the District of Columbia (DC) have legalized medical cannabis use, and 14 states and DC have legalized adult nonmedical use. This manuscript qualitatively summarizes cannabis policies across states with legal adult use marketplaces.

Methods Data are from state laws and regulations, collected through January 2021, and have been verified with state officials as part of ongoing state policy tracking efforts.

Results State policies differ in how cannabis products are taxed, where revenues are allocated, restrictions on the types of available products, restrictions on additives and flavors, product packaging and labeling, advertising restrictions, where cannabis can be consumed, and approaches to social equity.

Conclusion Timely, accurate, and longitudinal state and local cannabis policy data are needed to understand the implications of legalization. Careful study of policy differences across and within states is warranted, as differences may affect public health and consumer safety.

Introduction

Although cannabis with ≥0.3% delta-9-tetrahydrocannabinol (THC) concentration (also called marijuana) remains a Schedule I substance in the United States under the 1970 US Controlled Substances Act (1), state policies legalizing cannabis for medical and nonmedical use have increased rapidly over the past decade. As of January 2021, 36 states and the District of Columbia (DC) have legalized cannabis for medical use, and 14 of those states and DC have legalized nonmedical adult use of cannabis (at the time this article was written, South Dakota's adult use legalization was under legal challenge) (Figure 1).

Despite rapidly changing state policies legalizing both medical and adult nonmedical cannabis use, the science is still emerging around the health effects of cannabis (2,3). The 2017 National Academy of Sciences, Engineering, and Medicine reviewed the scientific evidence and found evidence that cannabis and cannabinoids are effective for the treatment of chronic pain in adults (though data from recent meta-analyses have suggested a more narrow application of cannabis for pain) (4), as antiemetics for chemotherapy-induced nausea and vomiting, and for improving patient-reported multiple sclerosis spasticity (2). The report also summarized moderate evidence for improved short-term sleep outcomes in individuals with sleep disturbance (2). States may authorize much broader medical use of cannabis (5), including indications that are not based on current scientific evidence (6).

The therapeutic effects of cannabis must be considered in the context of potential health risks. Cannabis use is associated with short-term impairments in learning, memory, and attention; impaired driving and increased risk for motor vehicle crashes; lower birth weight among babies born to mothers who

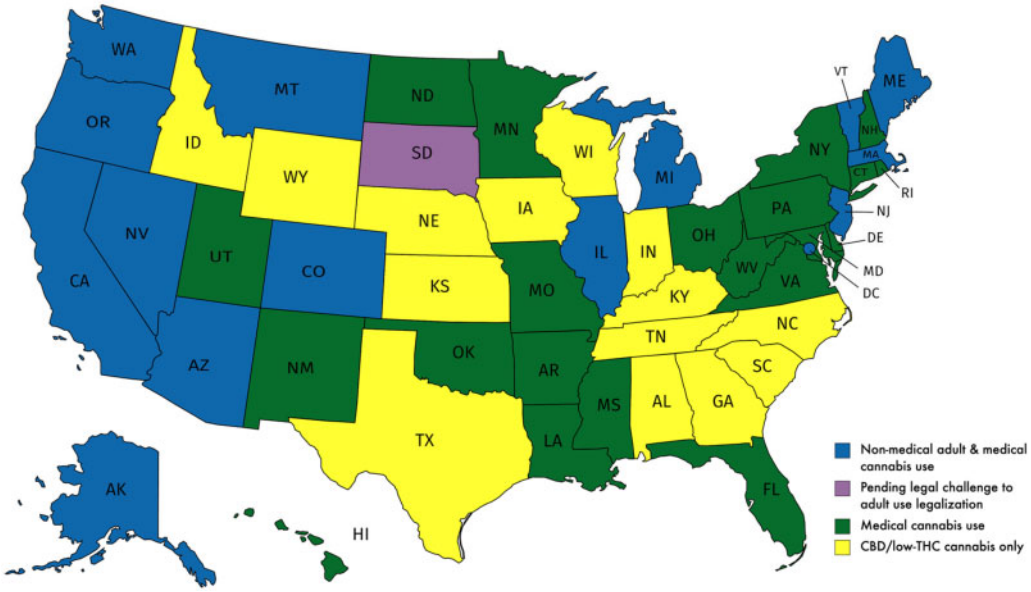

Figure 1. Cannabis policy by US state as of January 2021.

used cannabis; chronic bronchitis and other respiratory and cardiovascular symptoms; and increased risk for the development of schizophrenia and other psychoses, cannabis use disorder, and other substance use disorders (2,7,8). A number of these risks increase with earlier initiation and more frequent or heavy use patterns (2,7). The impact of cannabis use on cancer initiation and progression remains unclear, with some studies showing an association between cannabis use and occurrence of certain cancers, and others showing no association (2,7,9). Evidence does suggest an association between cannabis use and the development of nonseminoma testicular cancer (2,7).

Although research on the health benefits and risks of cannabis is currently limited and complicated by a number of factors (eg, the heterogeneity of products and modes of use, the Schedule 1 designation of cannabis federally, co-use of cannabis and other substances), some of the known and emerging potential risks of cannabis use could be minimized by thoughtful policymaking. Accordingly, the purpose of this review is to provide an overview of cannabis policy variables that are important to understand and study to minimize and prevent unintended public health and safety consequences from legalized cannabis. This manuscript describes adult use cannabis policies as of January 2021 in the 10 states that had adult use cannabis marketplaces in operation at that time.

Methods

Policy data reviewed in this document are qualitative in nature, not quantitative. Other data sources exist to provide quantitative data that can be used for research (eg, the National Institute on Alcohol Abuse and Alcoholism's Alcohol Policy Information System). These data have been collected by the author over the past 7 years through publicly available rules and regulations that states have enacted (see Table 1) and have been informally validated through state cannabis regulators and state public health officials at various timepoints. Policy data were initially collected to provide a more real-time view of state cannabis policies across a range of public health–oriented policy variables to aid state health officers in better understanding the policy landscape in their state and in surrounding states.

This report reviews nonmedical, adult use policies primarily from the 10 states that had operational adult use cannabis marketplaces as of January 2021. Four states legalized adult use either legislatively (Vermont) or through ballot measure (Arizona, Montana, New Jersey) in the fall of 2020 and, as of January 2021, had not yet finalized all rules and regulations for the marketplace; information from statutes and laws in those states is included in this policy summary, if available. DC is not included in these policy data, because they are not allowed to develop an adult use cannabis marketplace without US congressional approval.

This review summarizes major policy trends, similarities, and differences across states in a qualitative manner. Specific details about individual state policies can be located in the available rules and regulations cited in Table 1. Policy details reviewed are as of January 2021. It should be noted that policies can change rapidly in states, and the policies described below and the number of states with legal adult use cannabis marketplaces may have already evolved following the publication of this manuscript.

Results

As of January 2021, all states except for Illinois and Vermont have legalized adult use cannabis through ballot measures. Table 2 shows the percentage of support for the legalization ballot measure that passed in each state as well as the time between passage of the ballot measure and the opening of the marketplace. On average, states have taken approximately 15 months between ballot measure passage and market opening. This is a relatively short amount of time for states to set up an entirely new state marketplace, which may result in a focus that is more narrowly aimed at standing up and opening a new marketplace and less on ideal approaches through which to protect consumer health and safety or to promote social and economic equity.

Table 1. Links to cannabis-related rules and regulations in each adult use state with an operational marketplace as of January 2021

State	Links to state statutes and rules on cannabis
Alaska	Link to statutes (AS 17.38): https://www.commerce.alaska.gov/web/Portals/9/pub/MCB/StatutesAndRegulations/AS17.38.pdf Link to regulations (3 ACC 306): https://www.commerce.alaska.gov/web/Portals/9/pub/MCB/StatutesAndRegulations/3%20AAC%20306%208.23.20.pdf Link to cannabis testing compliance rules: https://www.commerce.alaska.gov/web/Portals/9/pub/MCB/StatutesAndRegulations/CannabisTesting.pdf
California	Link to the California Code of Regulations, Title 16, Division 42: Bureau of Cannabis Regulation: https://cannabis.ca.gov/wp-content/uploads/sites/13/2019/01/Order-of-Adoption-Clean-Version-of-Text.pdf Link to the California Code of Regulations, Title 17, Division 1: Manufactured Cannabis Safety: https://www.cdph.ca.gov/Programs/CEH/DFDCS/MCSB/CDPH%20Document%20Library/DPH17010_FinalClean.pdf Link to the California Code of Regulations, Title 3, Food and Agriculture. Division 8: Cannabis Cultivation: https://static.cdfa.ca.gov/MCCP/document/CDFA%20Final%20Regulation%20Text_01162019_Clean.pdf
Colorado	Link to the Code of Colorado Regulations, 212–3: Marijuana Enforcement Division—Colorado Marijuana Rules: https://www.sos.state.co.us/CCR/GenerateRulePdf.do?ruleVersionId=8439&fileName=1%20CCR%20212-3 Link to emergency rules: https://www.colorado.gov/pacific/enforcement/med-rules
Illinois	Link to the Cannabis Regulation and Tax Act (410 ILCS 705): https://www.ilga.gov/legislation/ilcs/ilcs5.asp?ActID=3992&ChapterID=35 Link to emergency rules: https://www.idfpr.com/forms/auc/68%20IAC%201291%20Adult%20Use%20Cannabis%20Emergency%20Rules.pdf General link to cannabis laws and rules: https://www.idfpr.com/profs/adultusecan.asp
Maine	Link to statutes: Title 28-B: Adult Use Marijuana: https://www.maine.gov/dafs/omp/adult-use/rules-statutes/title-28-b Link to regulations: 18–691 C.M.R.—Adult Use Marijuana Program: https://www.maine.gov/dafs/omp/adult-use/rules-statutes/18-691-C.M.R.-ch.-1 Link to all state adult use cannabis laws: https://www.maine.gov/dafs/omp/adult-use/rules-statutes Link to rulemaking activity (past and present): https://www.maine.gov/dafs/omp/adult-use/rules-statutes/rulemaking
Massachusetts	Link to statutes M.G.L. c. 94G, Regulation of the Use and Distribution of Marijuana Not Medically Prescribed: https://malegislature.gov/Laws/GeneralLaws/PartI/TitleXV/Chapter94G Link to regulations 935 CMR 500.000: Adult Use of Marijuana: https://mass-cannabis-control.com/wp-content/uploads/2019/11/Fall_2019_Adult_Regs_500.pdf Link to all state cannabis laws: https://mass-cannabis-control.com/the-laws/
Michigan	Link to all state cannabis laws, statutes, rules, and regulations: https://www.michigan.gov/mra/0,9306,7-386-82631—,00.html
Nevada	Link to Chapter 453D—Regulation and Taxation of Marijuana: https://www.leg.state.nv.us/Nac/NAC-453D.html Link to Title 56, Nevada Revised Statutes, Chapter 678A—Administration of Laws in Relation to Cannabis: https://www.leg.state.nv.us/NRS/NRS-678A.html Link to Title 56, Nevada Revised Statutes, Chapter 678B—Licensing and Control of Cannabis: https://www.leg.state.nv.us/NRS/NRS-678B.html Link to Title 56, Nevada Revised Statutes, Link to Chapter 678D—Adult Use of Marijuana: https://www.leg.state.nv.us/NRS/NRS-678D.html Link to Nevada Cannabis Compliance Regulations—NCCR 1–14: https://3aenxi2dowkx1fsfejubgrx1-wpengine.netdna-ssl.com/wp-content/uploads/2020/08/Final-Effective-NCCR.pdf
Oregon	Link to Oregon Revised Statutes, Chapter 475B—Cannabis Regulation: https://www.oregonlegislature.gov/bills_laws/ors/ors475B.html Link to Oregon Administrative Rules—Chapter 845, Division 25—Recreational Marijuana:

(continued)

Table 1. (continued)

State	Links to state statutes and rules on cannabis
Washington	https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=3873 Link to Washington Administrative Code (WAC)—Title 314: Liquor and Cannabis Board Rules: https://apps.leg.wa.gov/wac/default.aspx?cite=314 Link to WAC 314–55: Marijuana Licenses, Application Process, Requirements, and Reporting: https://apps.leg.wa.gov/wac/default.aspx?cite=314-55

Table 2. Timeline of nonmedical adult use cannabis legalization, by state, as of January 2021[a]

State	Year adult use legalization passed	Ballot measure (% support) OR legislative passage	Date retail marketplace opened
CO	2012	Ballot measure (55%)	January 2014
WA	2012	Ballot measure (56%)	July 2014
OR	2014	Ballot measure (56%)	October 2015 (through medical dispensaries)
AK	2014	Ballot measure (53%)	October 2016
DC	2014	Ballot measure (65%)	No retail marketplace approved
CA	2016	Ballot measure (56%)	January 2018
ME	2016	Ballot measure (50%)	October 2020 (through medical dispensaries)
MA	2016	Ballot measure (54%)	November 2018
NV	2016	Ballot measure (54%)	July 2017 (through medical dispensaries)
VT	2018	Legislative	Expected 2022
MI	2018	Ballot measure (56%)	December 2019
IL	2019	Legislative	January 2020 (through medical dispensaries)
AZ	2020	Ballot measure (60%)	January 2021 (through medical dispensaries)
MT	2020	Ballot measure (57%)	Expected 2022
NJ	2020	Ballot measure (67%)	Expected 2022
SD	2020	Ballot measure (54%)	Legalization overturned by legal challenge

aAK = Alaska; AZ = Arizona; CA = California; CO = Colorado; DC = District of Columbia; IL = Illinois; NJ = New Jersey; MA = Massachusetts; ME = Maine; MI = Michigan; MT = Montana; NV = Nevada; OR = Oregon; SD = South Dakota; VT = Vermont; WA = Washington State.

Who Regulates Cannabis?

It is important to understand which agencies serve as the primary regulators of cannabis, because a cannabis regulatory agency may have preexisting regulatory approaches that can shape regulation (eg, from an alcohol perspective, from a financial perspective, from a public health perspective). Initial cannabis regulators in the first states with legal adult cannabis use (ie, Colorado, Washington, Oregon, and Alaska) were Alcohol and Beverage Control Boards and Departments of Revenue. Massachusetts was the first adult use state to set up a standalone Cannabis Control commission as the regulatory authority, an approach that has since been followed by Nevada and New Jersey. Although public health agencies are the primary regulators of medical cannabis, they have not generally been given regulatory authority over adult cannabis use [with the exception of California, where the Department of Public Health has had regulatory authority over manufactured (eg, processed) cannabis (10), and Arizona, where the Health Department was named as the regulatory authority in the ballot measure that passed in November 2020] (11). Local jurisdictions have a regulatory role in most states; however, it is typically limited to time, place, manner, and setting and enforcing zoning and building codes, though some local jurisdictions have established licensing programs.

What Are the Taxes on Cannabis?

The price of cannabis products, which is impacted by taxation, can be used to influence consumer purchasing behavior and can influence consumers towards or away from purchase of certain products. For example, researchers have suggested that taxing based on THC content in a product may incentivize cannabis users to move away from higher THC products (12,13), which have been associated with a range of health effects (2,14).

With the exception of Alaska, all states have an ad valorem excise tax charged at the time of retail sale, ranging from 6.6% in New Jersey to 37% in Washington State (with most falling between 10% and 15%) (Table 3). Illinois is the first and only state to date to tax at the point of sale based on the THC content, with a 10% tax on cannabis flower or products with less than 35% THC content, a 20% tax on cannabis-infused products (eg, edibles), and a 25% tax on any products with over 35% THC (15). A number of states also have a general state sales tax added on top of the excise tax (Table 3). Many states have wholesale taxes as well, typically based on product classification and by weight, or collected at the producer level and based on total retail sales (Table 3).

Where Are Tax Revenues Allocated?

The allocation of tax revenue is also important to understand, because revenues could be used to mitigate potential public health and safety risks, to fund youth prevention campaigns and treatment programs, and to collect data to inform policy and public health work. Revenues could also be reinvested to support a range of needs in communities disproportionately impacted by the criminalization of cannabis, which could yield public health benefits and promote health equity.

Table 3. Details on nonmedical adult use cannabis taxes and possession, by state, as of January 2021

State	Tax[a]	Adult use homegrow allowed?	Legal possession?
AK	Cultivation/wholesale tax: $50/oz for mature flower, $25/oz for immature flowers, $15/oz for trim; $1 per clone.	Yes, 6 plants/adult, 3 flowering; limit 12 plants per residence	1 oz
CA	State retail excise tax: 15% of retail price (+7.25% general state sales tax) Cultivation/wholesale tax: $9.65/oz for flower, $2.87/oz for leaves; $1.29/oz for fresh plant material.	Yes, 6 plants/adult	1 oz (28.5g) of flower or 8g concentrate
CO	State retail excise tax: 15% tax on retail sales Cultivation/wholesale tax: 15% tax on retail sales.	Yes, 6 plants/adult, 3 flowering at time; limit 12 plants per residence.	1 oz flower or equivalent (equivalence = 8 g concentrate, 800 mg edibles at purchase)
IL	State retail excise tax: • 10% tax for products with ≤35% THC; • 20% tax for cannabis-infused products (edibles); • 25% tax for products with >35% THC (concentrates). Cultivation/wholesale tax: 7% gross receipts tax on salefrom cultivators to retailers	No (but allowed for approved medical patients)	For IL residents: 30 g flower/5g concentrate/500 mg edible For visitors: half resident limits
MA	State retail excise tax: 10.75% of sales (+6.25% general state sales tax)	Yes, 6 plants/adult; limit 12 plants per residence	<1 oz on person, <5 g concentrate <10 oz at home
ME	State retail excise tax: 10% tax on retail sales Cultivation/wholesale tax: mature flower: $335/lb, trim $94/lb, immature/seedlings: $1.50, seeds: $0.30/per seed	Yes, 3 flowering plants, 12 nonflowering plants and unlimited seedlings	2.5 oz, including 5g of concentrate
MI	State retail excise tax: 10% tax on retail sales (+6% general state sales tax)	Yes, 12 plants (and up to 10 oz marijuana produced by the plants)	2.5 oz, no more than 15 g concentrate
NV	State retail excise tax: 10% tax on retail sales (+6.85% general state sales tax) Cultivation/wholesale tax: 15% of sales	Yes, 6 plants for personal use if > 25 miles from a retail marijuana store	1 oz of marijuana or 1/8th oz of concentrates 2.5 oz for medical
OR	State retail excise tax: 17% tax on retail sales	Yes, 4 plants per residence	1 oz flower in public, 8 oz at home; 16 oz solid product, 72 oz liquid product; 16 oz concentrates, 1 oz extract
WA	State retail excise tax: 37% tax on retail sales (+6.5% general state sales tax; qualifying medical patients can be exempt)	No (but allowed for approved medical patients)	1 oz usable, 7 g concentrate, 16 oz solid edible, and 72 oz beverage or topical

aCannabis may also be subject to local excise taxes and general local sales taxes that are not included here. AK = Alaska; CA = California; CO = Colorado; IL = Illinois; MA = Massachusetts; ME = Maine; MI = Michigan; NV = Nevada; OR = Oregon; and WA = Washington State.

Beyond tax allocations to regulate the marketplace, state cannabis tax revenues are allocated to a variety of areas, with at least 7 states allocating funds to schools; 5 states allocating funds to public safety, traffic safety, or roads; 4 states allocating funds to local governments; 2 states allocating funds to basic health or health care; and 3 states allocating funds to criminal justice reforms and/or reinvestment in communities disproportionately affected by prior criminalization of cannabis. At least 7 states have allocations to public health, behavioral health, and/or substance abuse, although to date, those allocations have been relatively small and may supplant other funding sources. Four states allocate some tax revenue toward funding research activities, with funds typically going directly to universities in the state.

How Is the Marketplace Structured?

All states issue licenses for cultivators (growers), processors, and retailers, with some variation on cultivation size and licensing approaches (eg, how licenses are granted). A number of states allow any entity that qualifies to obtain a license. Four states have some limitations on the number of licenses available statewide (Arizona, Illinois, Nevada, and Washington). With the exception of Washington, all states allow (but do not require) vertical integration, which means that the same entity can be licensed to grow, process, and sell cannabis. In Washington, neither a cannabis producer nor processor can have a financial interest in a cannabis retailer.

Are Adults Allowed to Grow Cannabis at Home?

Homegrow, or the ability to grow the plant at home, can have implications for public health and safety. Whereas homegrow may be important for medical patients who have specific plant strains they are using medically, adult use homegrow has been associated with increased diversion and public health risks related to youth access and dependence (13,16,17). Furthermore, products grown at home are not subject to any analytical testing requirements and are thus unlikely to be tested for contaminants, including yeast, mold, heavy metals, and mycotoxins. Homegrow is allowed for adult, nonmedical use in all states except for Illinois and Washington, which both allow medical homegrow, but not homegrow for nonmedical use (Table 3).

What Is Legal in Terms of Possession?

Legal limits on cannabis possession often translate into legal purchase limits (eg, you cannot purchase more than you can possess). As noted in a recent publication by Pacula et al. (14), legal purchase limits in all adult use states translate into levels of THC that typically correspond to what someone who uses cannabis daily might consume over a month, leading to public health and safety concerns about diversion and about consumption high amounts of THC. Most states have legalized possession of 1 ounce of cannabis, or an equivalent amount of 7-8 g of THC concentrate (Table 3). Maine and Michigan allow for possession of up to 2.5 ounces of cannabis. Massachusetts and Oregon have greater possession limits at home (10 ounces and 8 ounces, respectively).

What Types of Cannabis Products Are Legal?

Although research is insufficient to fully understand comparative risks across different types of cannabis products (2,18), each class of cannabis product (ie, plant, edibles, concentrates) has differing potential public health and consumer safety concerns. As of January 2021, adult use states have very few restrictions on the types of cannabis products that can be sold, allowing a wide variety of smoked, vaped, edible or infused, and concentrated products. Three states (California, Michigan, and Washington) have limits on edibles, requiring them to be shelf-stable and/or nonperishable to minimize certain food safety risks (Table 4). Most states have also banned adulterated products—ready-to-market, prepackaged products with THC added before sale. Colorado has a particular class of products that resemble existing noncannabis medical products (eg, metered dose inhalers or nasal sprays, and vaginal or rectal suppositories) that require a specific audit to provide an added level of oversight and consumer-safety (19).

Are There Limits on THC in Products?

Initial regulations for adult use cannabis did not set serving-size limits on cannabis edibles. After a number of prominent overconsumption cases involving edibles (20–22), all states now have THC serving-size limits for edibles and other consumable cannabis products. As of January 2021, four states (Alaska, Oregon, Massachusetts, and Vermont) have 5 mg THC per serving, typically up to 50 mg per package, and the remaining states have 10 mg THC per serving, typically up to 100 mg per package (Table 4). One state (Washington) also requires the servings within a package to be individually wrapped (23). However, these serving sizes do not extend beyond edibles and infused products in any state, and highly concentrated THC products with far more than a 5- or 10-mg THC serving size are widely available. Though their adult use cannabis marketplace is not yet open, laws in 1 adult use state—Vermont—cap the THC concentration in products, limiting cannabis flower to no more than 30% THC, and cannabis oils can contain up to 60% THC (24). No oils or concentrates beyond cartridges for vape pens will be allowed in Vermont's adult use marketplace (24). Research is warranted to understand how caps on THC and bans on certain classes of products affect both the illicit market and the use of other noncannabis ingredients (e.g., excipients, diluents, flavors) that may pose consumer safety risks.

What Types of Ingredients Are Prohibited in Cannabis Products?

The e-cigarette or vaping product use–associated lung injury (EVALI) (25) outbreak that occurred in 2019 and was attributed in part to Vitamin E acetate (VEA) found in cannabis vape cartridges (26) underscored the importance of regulation of the types of ingredients in cannabis products, particularly those that are smoked or aerosolized. The EVALI outbreak resulted in nearly 3000 hospitalizations across all 50 states and at least 68 deaths (25), and the CDC could not rule out other potential causes beyond VEA. In the wake of the EVALI outbreak, a number of states have explored policies to limit certain excipients, diluents, and terpene flavoring blends that may be added to vape cartridges and have unknown safety profiles. Many states have either banned or now test for VEA; Colorado also has banned medium-chain triglycerides (MCT) oil and polyethylene

Table 4. Adult use cannabis product restrictions and regulations, by state, as of January 2020

State	Prohibitions on types of cannabis products	THC serving sizes in edibles?	THC concentration caps?	Restrictions on flavors in vape cartridges?	Restrictions on other excipients and diluents in vape cartridges?	Required product preapproval?
AK	None	5 mg/serving; 50 mg/package	None	None	None	None
CA	Shelf-stable edibles only	10 mg/serving; 100 mg/package	None	None	None (but additives for manufactured cannabis products must be on the FDA GRAS list [a])	None
CO	None, However, specific approval process for audited products (see required preapproval section)	10 mg/serving; 100 mg/package	None	None	Banned use of Vitamin E acetate, polyethylene glycol, and MCT oil Additives for metered dose inhalers or vaporizers must be on FDA (or equivalent international agency) inactive ingredient list for inhalation.[a]	Required preapproval for audited products, which include metered-dose inhalers and suppositories
IL	None	10 mg/serving; 100 mg/package	None	None	None	None
MA	None	5 mg/serving; 100 mg/package	None	None (but specific labeling required)	None (but required testing for Vitamin E acetate)	Optional preapproval for products
ME	None	10 mg/serving; 100 mg/package	None	None (but additives may not be "toxic or harmful")	None (but additives may not be "toxic or harmful")	None
MI	Shelf-stable edibles only	10 mg/serving; 100 mg/package	None	Botanical terpenes that are chemically identical to terpenes found in cannabis sativa L. are allowed. All other inactive ingredients must be approved by FDA for the intended use.	Banned use of target analytes, which includes Vitamin E acetate	None
NV	None	10 mg/serving; 100 mg/package	None	All ingredients must be approved. Total terpenes must be <10% of product.	Banned use of Vitamin E acetate and polyethylene glycol All ingredients must be approved and must be on the FDA inactive ingredient list. [a]	Required preapproval for ingredients, menu and ingredient changes, packaging

(continued)

Table 4. (continued)

State	Prohibitions on types of cannabis products	THC serving sizes in edibles?	THC concentration caps?	Restrictions on flavors in vape cartridges?	Restrictions on other excipients and diluents in vape cartridges?	Required product preapproval?
OR	None	5 mg/serving; 50 mg/package	None	Banned 2 specific terpenes: Squalene, squalane	Banned use of Vitamin E acetate, polyethylene glycol, MCT oil, and dimethylsulfoxide	Required preapproval for cannabis packaging and labeling
WA	Shelf-stable edibles only	10 mg/serving; 100 mg/package	None	Vapor products can have a characterizing flavor if it is derived from botanical terpenes identical to those naturally occurring in the cannabis plant. Synthetic terpenes are not allowed.	Banned use of Vitamin E acetate	Required preapproval for edibles only

[a]FDA Inactive Ingredient List presents US Food and Drug Administration Inactive Ingredient Database: https://www.accessdata.fda.gov/scripts/cder/iig/index.Cfm. FDA GRAS presents US Food and Drug Administration Generally Recognized as Safe List (for food and food additives): https://www.fda.gov/food/food-ingredients-packaging/generally-recognized-safe-gras. AK = Alaska; CA = California; CO = Colorado; IL = Illinois; MA = Massachusetts; ME = Maine; MI = Michigan; NV = Nevada; OR = Oregon; and WA = Washington State.

glycol (19), and Oregon has issued a rule to ban squalane, squalene, propylene glycol, and triglycerides (including MCT oil) (27), which have not been shown to be safe for aerosolization (28) (Table 4).

Oregon and Washington State had emergency orders temporarily banning added noncannabis–derived flavors during the EVALI outbreak (28,29). Those bans are no longer in place. Nevada's rules have accompanying guidance that currently limits the proportion of added terpenes allowed in vape oils to no more than 10% of the product, which is at the high end of the ratio of terpenes that might be found naturally occurring in the plant (30). Vermont's new law will allow only flavors that are naturally occurring in the cannabis plant (24). More research is warranted to better understand the safety profile of various excipients, diluents, and added terpenes, and to ascertain whether certain ways that cannabis flavors may or may not appeal to youth.

How Are Products Tested?

Protecting public health and consumer safety depends not only on regulating what goes into the products but also testing the products—both to enforce compliance with existing regulations and to assess the presence of other possible contaminants (eg, molds, pesticides, bacteria) that could pose harms to public health. All adult use states license in-state third-party laboratories to conduct cannabis testing. Although all states require laboratory accreditation (usually to an International Organization for Standardization or ISO 17025 standard), laboratories have a limited number of in-state industry licensees as their customers, and instances of "lab shopping" to obtain the highest THC test result have been documented (31,32). In part because of the federal Schedule I designation, state-based laboratories are typically not engaged in laboratory testing (33). States also have generally struggled to set up state reference laboratories (typically large state or academic laboratories), which could validate third-party laboratory results, provide information in cases of differences in testing results across laboratories, and serve as a check and balance on the testing system (33,34).

All adult use states test for cannabinoid concentration and residual solvents. Most also test for pesticides and microbials. Approximately two-thirds of states test for mycotoxins, water activity or moisture, heavy metals, and yeast or mold (Table 5). States vary in terms of when in the production process products are tested and whether finished product testing is conducted. States also vary regarding sampling for product testing, with some states having the third-party laboratory collect samples and others having licensees submit samples. Sampling and process validation for testing vary by state. Testing methods, thresholds, and protocols also vary across states and across different contaminants and product types. Standardization across states is warranted to better protect consumer safety.

How Are Products Packaged and Labeled?

Packaging and labeling of products is important both to educate consumers about the products they are consuming and to prevent products from appealing to or being easily accessible to youth. All adult use states now require child-resistant packaging, typically in an opaque package that is resealable if the product contains multiple servings, in compliance with US Poison Prevention Packaging Act Standards (35). All states have general regulations that product packages cannot appeal to

Table 5. Adult use cannabis contaminant testing requirements, by state, as of January 2021[a]

State	Cannabinoid concentration	Residual solvents	Microbials (bacterial/ fungus)	Yeasts/molds	Mycotoxins	Water activity/moisture	Heavy metals	Pesticides/ chemical residue	Foreign matter
AK	X	X	X				X		
CA	X	X	X		X	X	X	X	X
CO	X	X	X	X	X		X	X	
IL	X	X	X	X	X			X	
MA	X	X	X	X	X		X	X	
ME	X	P	X	X		X		P	X
MI	X	X	X		X	X	X	X	X
NV	X	X	X	X	X	X	X	X	X
OR	X	X				X	P	X	
WA	X	X	X	X	X	X			

[a]In many states, testing requirements vary somewhat across different product types (eg, inhalable, infused, concentrate). AK = Alaska; CA = California; CO = Colorado; IL = Illinois; MA = Massachusetts; ME = Maine; MI = Michigan; NV = Nevada; OR = Oregon; P = Pending or Planned; WA = Washington State.

Figure 2. Existing cannabis universal symbols by state as of January 2021.

and/or target youth. Most specify that packaging should not depict product use, or contain cartoons, toys, shapes, or designs that would appeal to minors. At least 1 state, Massachusetts, specifies no bright or neon colors on packaging. A number of states prohibit the use of the word "candy" or "candies" on labeling. States also may prohibit certain fonts that may be appealing to minors (eg, cartoon-like fonts).

These regulations can be particularly challenging for states to enforce, because they typically outline what should not be included and leave room for interpretation. Three states (Nevada, Oregon, and Washington) have required preapproval processes in place for some or all new cannabis product packages (Massachusetts has an optional preapproval process). Preapproval typically consists of a regulatory staff member reviewing all packaging and often ingredients as well. No adult use states to date have adopted plain or uniform packaging, which standardizes most or all elements of a package, though Massachusetts regulations require the package to be opaque and plain in design. Canada has adopted plain packaging for cannabis products, allowing for a small, branded element on the standardized package (36). Plain or uniform packaging could simplify enforcement. In addition, emerging evidence from cannabis-related research and evidence from tobacco product research suggest that plain packaging reduces the appeal to minors (37–39).

In terms of labeling, 8 states now require a "universal symbol" (see Figure 2) that serves to denote visually that the product contains cannabis. A universal symbol is important for preventing accidental consumption of products that may look like consumable noncannabis products. Universal symbols vary across states, with the exception of Massachusetts and Maine, who share the same symbol. In some states (eg, Colorado, Massachusetts, Maine, Nevada), the universal symbol is required to be marked, stamped, or otherwise imprinted onto each serving size of multiple-serving cannabis edible products (ie, on each serving of a candy bar with 10 scored servings).

More research is warranted to assess how effective universal symbols in states are in terms of denoting to both adults and youth that the product contains cannabis in a neutral, nonappealing manner. Three states (Washington, Massachusetts, and Maine) also require a symbol specifically noting in a visual way that the product is not safe for children. Washington's symbol is accompanied by the poison center phone number. Although a uniform universal symbol across states may have benefits in terms of consumer recognition of cannabis containing products in the current state-by-state legalization framework, differing

Table 6. Health warning label requirements for adult use cannabis products, by state, as of January 2020

	Keep away from children	Pregnancy/ breast feeding	Delayed intoxication[a]	Driving/machinery/ impairing	Addictive / dependence risk	General health risks	Unlawful outside of state	Smoking is hazardous[b]
AK	X	X		X	X	X		
CA	X	X	X[a]	X		X		
CO	X	X	X[a]	X		X	X	
IL	X[a]	X	X[a]	X	X		X	X
MA	X	X	X[a]	X		X		
ME	X[a]	X	X[a]	X		X		
MI	X	X		X				
NV	X		X		X		X	
OR	X			X				
WA	X		X[a]	X	X		X	X

aFor manufactured cannabis products or cannabis-infused products only. AK = Alaska; CA = California; CO = Colorado; IL= Illinois; MA = Massachusetts; ME = Maine; MI = Michigan; NV = Nevada; OR = Oregon; WA = Washington State.
bFor combusted products only.

universal symbols may also assist in identifing the origins of diverted products that come from the legal state marketplaces.

Warning labels provide an opportunity to clearly communicate to consumers specific health and safety warnings about the product. All adult use states require warning labels on cannabis products. However, warning statements differ widely across states (see Table 6). To date, warning labels for cannabis read more like a legal disclaimer, listing a number of possible risks and consumer safety concerns in small 4- or 6-point font on a single label. This approach is unlikely to increase knowledge or awareness of potential risks in consumers. Canada, on the other hand, has standardized packaging across provinces that includes a large yellow warning label occupying one-half of the cannabis package and depicting a single rotating warning randomly selected from a number of required warnings (36).

Adult use states require a variety of additional items on labels, including the cannabinoid content, a list of all non-cannabis inactive ingredients (usually in descending order by weight), allergen information, nutritional information, and track and trace number and/or batch number. A number of states provide optional, recommended labeling as well, including harvest or production data and a "best by" date. All adult use states prohibit health or benefit claims and/or false claims. A few states prohibit the use of certain words, such as "organic" on labels (eg, Alaska, Maine, Nevada, and Washington).

What Requirements Exist for Retail Stores and the Retail Environment?

Research on the availability of other substances (eg, tobacco, alcohol, etc) has found that regulating the location of retail outlets and regulating outlet density can prevent youth access and exposure (38,40,41). Accordingly, most states have setback requirements that prohibit cannabis retail stores from being located within a certain distance (typically 500-1000 feet) of a child-based location (eg, schools, childcare centers, community centers). Most states allow local authorities to change the setback requirements, and some (eg, Illinois) defer to local governments in terms of setting these setbacks. These types of setbacks can further limit ease of access to youth. However, when not coupled with density caps, they can result in a proliferation of stores in certain neighborhoods (often low-income neighborhoods) (42–44). Despite this evidence, few states have caps on the number of retail licenses. Washington, Nevada, Illinois, and Arizona have capped the number of retail licenses available in the state, typically based on county size or by population.

In all states, stores have mandatory ID checks upon entry or before purchase, and compliance with underage ID checks is generally quite high (ie, >90% compliance since 2018 in Washington State) (45). In all adult use states, retail cannabis stores are prohibited by statute, rule, or guidance from selling any nicotine or tobacco or alcohol products. Stores also are typically limited to selling only cannabis products (although some states allow the sale of branded apparel and paraphernalia). Nevada requires stores to sell lockboxes to facilitate safe storage of cannabis products at home (46).

Where Are People Allowed to Consume Products?

In states that have legalized adult cannabis use, it has effectively been legalized only for people who own their own home, because use in rental properties and federal or state housing is generally not permitted, and states have banned general public consumption of cannabis (although in most jurisdictions, public use of cannabis is a civil infraction with limited fines). States have faced pressure to provide a place for medical cannabis consumers to safely use cannabis, and for tourists to consume cannabis. Based largely on these issues, a number of states have moved to allow for some legal cannabis consumption onsite in retail cannabis stores or in other businesses licensed for cannabis consumption (19,47,48). These policy decisions have implications for public health and safety. Secondhand cannabis smoke appears to have many of the same constituents as tobacco smoke (49), and animal models show that it can cause some of the same harmful cardiovascular effects (50). This raises the question of potential public health risks to workers employed by businesses that allow for indoor cannabis consumption. In addition, although all states with state licensing for cannabis consumption have expressly prohibited consumption of nicotine or tobacco products or alcohol, because cannabis and nicotine or tobacco can be combined in products (51,52) and increasingly are consumed in devices that look alike (53), enforcement of prohibitions of nicotine or tobacco consumption

in public spaces where cannabis consumption is legal will be difficult. It is likely that exceptions to state Clean Indoor Air Act policies for cannabis could effectively allow for the use of nicotine or tobacco products in indoor public spaces again, which would result in substantial human harms (38,54).

In Maine, Nevada, Oregon, and Washington State, it remains illegal to consume cannabis in any public space. Cannabis is not allowed to be consumed in any public or retail space in Massachusetts. Although the Massachusetts Cannabis Control Commission has authorized a license for social consumption, the state law needs to be amended before any licenses can be granted. California and Illinois have pushed the issue to local governments and allow certain exemptions to the statewide Clean Indoor Air Act if localities approve (and some localities in both states have approved exemptions). In Illinois, the local exemption can allow for onsite consumption at cannabis retail stores and in licensed smoke shops (15).

Statewide licenses for social or onsite consumption are available in Alaska, Michigan, and Colorado. In Alaska, the state will only issue an onsite consumption license if there is a local endorsement in place (55). Consumption of dried flower and vape oil is allowed inside marijuana retail stores in isolated consumption areas that must be separated by walls and a secure door, have a smoke-free area for employees to monitor the area, and have a ventilated system that is separate from other areas of the retail store. Consumption by any method is allowed in an outdoor area if it is obscured from view, not located near air intake vents, and approved by the surrounding property owners (55–57). In Michigan, rules designate a consumption establishment license that is available to anyone (it is not limited to existing retail licensees) with a local approval requirement (58). The license allows for cannabis consumption (of any licensed marijuana product) in an adult-only commercial space. Similar to Alaska, the space must have a smoke-free area for employees to monitor consumption, must be physically separated from other areas of the space where smoking is prohibited, and must have a separate ventilation system. Cannabis products can only be distributed or sold onsite if the social consumption licensee also has a license as a cannabis retailer or a microbusiness; cannabis products also are allowed to be delivered to the social consumption establishment (58). In 2019, Colorado legalized licensed cannabis "hospitality businesses" (59). The policy takes an opt-in approach and requires local approval. Indoor and outdoor consumption of specific amounts of dried flower, concentrate, or THC-containing edibles is permitted provided outdoor consumption is obscured from view. The policy also legalized consumption in a "mobile premise" (eg, a car or bus) provided it has ventilation to ensure that air is not circulated into the driver's area. Some restricted food sales are permitted, and the license can be granted to a food establishment provided the marijuana consumption area is isolated from the rest of the food establishment (59).

What Advertising Is Allowed?

Advertising is an important way that commercial industries reach youth, and can alter social norms, lead to initiation, and facilitate heavier use patterns (13,60). The United States protects commercial speech in the first amendment of the US Constitution, although constitutional scholars disagree on how protections apply to speech about a federally illicit substance (61–63). Advertising can occur through radio, TV, and print sources, as well as out-of-home sources such as billboards and other signage, sponsorships, and social and digital media. Although a number of medical cannabis states have broad-scale advertising bans in place prohibiting the use of all or most of these outlets, no adult use states have outright banned advertising through these mediums.

Many adult use states have set standards that cannabis-related advertising is only permitted if 71.6% of the viewers can reasonably be expected to be aged 21 years and older. This standard is drawn from a standard that the alcohol industry set for themselves (64). However, this approach sets a standard that still allows for up to nearly 30% of the audience to be under the age of 21 years. Although cannabis-related advertising is broadly allowed in adult use states, some states have restrictions in place. In California, Maine, and Washington, there are restrictions on billboards. In California, billboards cannot be placed on interstate highways or state highways that cross state boarders. In Maine, billboards are not permitted for any businesses, including cannabis businesses. In Washington, billboards are allowed solely for the purpose of identifying the name of the business, the nature of the business, and public and directional information about the licensed retail outlet. States increasingly also have restrictions on other out-of-home advertising approaches, including transit signs, sandwich boards, and sign spinners. For example, Washington implemented advertising restrictions on sign spinners and sandwich boards in 2017 (23), and Illinois, Massachusetts, Nevada, and Washington all ban cannabis advertising in and/or around public transit. To date, few policies exist to regulate digital advertising or advertising on social media (ie, through influencers and spokespeople), and enforcement of policies in this space (like age restrictions, for example) presents a challenge.

Five states (Massachusetts, Maine, Nevada, Oregon, and Washington) now require warning statements on ads (eg, ranging from warnings in line with product warning labels to warnings that cannabis is for use by those aged 21 years and older only—"Keep out of reach of children"). Six states also have setback requirements, prohibiting advertising within 1000 feet of a child-related or community-based location (locations vary by state). Similar to packaging and labeling restrictions, most states prohibit images that could appeal to youth, depict consumption, or use the cannabis leaf. However, all of these restrictions pertain only to entities that the state cannabis regulator licenses (ie, producers, processors, and retailers). To date, third-party cannabis-affiliated groups that are not licensees in the state have not been subject to any state restrictions and have been allowed to advertise through a range of modalities.

What Social Equity Provisions Exist?

For decades, minority communities in the United States have been disproportionately arrested for cannabis possession and use (65). Although legalization in a number of states have been motivated by social justice goals (eg, in Washington State, the ACLU sponsored the initiative to legalize cannabis), legalization did not resolve these disparities, and it created a profitable industry that has largely shut out these communities. For example, evaluation data from Washington State showed that initial efforts at legalization without specific social equity measures in place reduced overall arrests but did not reduce the disparity of arrests between Black and White people (66).

States have begun to address social equity and social justice through policies that attempt to 1) prioritize licensing, capital, and technical assistance for individuals from disproportionately

affected communities who want to work in the industry; 2) expunge cannabis-related criminal records; and 3) create grant programs for reinvestment into communities that have been disproportionately affected by the prior criminalization of cannabis. In particular, 2 states (California and Illinois) have each allocated upwards of $50 million to date on grants that take a trauma-informed approach to broader-scale community reinvestment, including reentry programs, facilitating access to health care, system navigation services, job placement services, and behavioral health services (67,68). Given that criminal justice involvement has been shown to have a host of direct and indirect effects on health and health care (69–71), these types of community reinvestment programs may be particularly important in terms of closing health disparities.

Discussion

As these findings suggest, state cannabis policies differ in particular areas that may have implications for public health and consumer safety, including how cannabis products are taxed, where tax revenues are allocated, what restrictions are placed on the types of products, additives and flavors that are legal, product packaging and labeling, where consumption of cannabis is allowed, advertising restrictions, and social equity programs. Studying these policy differences and their impacts on health will be important to inform future policymaking.

All states that have legalized adult use cannabis marketplaces to date have done so through a commercial model that may incentivize market outcomes (eg, increased sales, consumption, etc) that can be at odds with public health goals (eg, reducing dependence, preventing underage consumption, etc) (60,72). This is further complicated by the fact that other policy goals with public health benefit—such as reducing the illicit market—may require approaches that also pose unintended public health harms. For example, reducing price to capture the illicit market can make products more accessible to youth and underage consumers (72).

Developing evidence-based policies to protect public health and consumer safety in a legal cannabis market will necessitate timely data collection and policy research. However, data collection around cannabis policies, cannabis use, and related behaviors has been insufficient at both the state and federal levels (73). Detailed policy data and timely data on cannabis use health and related outcomes are needed and could be used together to identify the best policies for limiting potential harms, protecting consumer safety, and promoting equity. However, current data monitoring systems are generally missing key indicators to assess the current landscape of products, modes of consumption, and health and safety outcomes. In many cases, valid and well-tested indicators have not yet been developed to provide the information needed to study the potential effects of policy changes on changing patterns of consumption. Furthermore, state and federal agencies have not had sufficient funding to make improvements to data collection systems to obtain the information needed to inform public education, research, and policy. Although 2 existing policy tracking systems that were developed for broader research purposes have added longitudinal cannabis policy tracking (the Alcohol Policy Information System and the Prescription Drug Abuse Policy System), policy data are more than a year old, limiting their ability to inform real-time policy and public health efforts and to quickly identify current similarities and differences across states. Given the fast pace of cannabis policy in US states, a more frequently updated policy database that catalogs both state-level and local-level policy variation is warranted.

Consumer awareness about cannabis products and health and safety considerations has also not been prioritized. Although this review focused on policies related to the regulation of adult use cannabis marketplaces, policies vary widely across medical cannabis programs as well, with some having more consumer protection and education in place than others. Increasingly, as patients may seek cannabis products for medicinal use in the growing adult use marketplace (eg, without the guidance or oversight of a clinician), consumer education is even more important.

Furthermore, with the proliferation of hemp and cannabidiol (CBD) products in virtually all state marketplaces (74,75), consumers may be confused about what they are consuming, the safety of the products, and the potential benefits and risks. The line between cannabis (marijuana) and hemp may be blurring further for consumers as THC isomers (such as delta-8 and delta-10 THC) and other novel cannabinoids that are impairing and psychotropic from hemp and sold across state lines (76). In most states, the regulations for hemp differ greatly from the regulations for cannabis, particularly with regard to product testing, packaging, labeling, and retail sale. Gaining some parity across hemp and cannabis policies is important for the safety of both medicinal and nonmedical consumers.

This qualitative summary of cannabis policy across states with legal adult use marketplaces is subject to at least 3 limitations. First, cannabis policies evolve rapidly, and data reported in this manuscript may become outdated. For example, in the process of publishing this manuscript, at least 4 other states have legalized adult use cannabis marketplaces (New Mexico, Virginia, New York, and Connecticut). Despite how quickly cannabis policies change within and across states, there is value in studying policy as it evolves, and this study serves as a snapshot of cannabis policy data at a point in time. Second, this review included data only from state cannabis policies; localities in some states have different policies, and the regulatory reality around cannabis marketplaces varies within some states. Finally, this is a qualitative and largely narrative report of cannabis policies across select states and does not serve as a substitute for a robust quantitative legal review of existing policies, similar to the approach undertaken by the legal team that works on the National Institute on Alcohol Abuse and Alcoholism's Alcohol Policy Information System. A barrier of the rigorous legal review of policy is timeliness. Review using legal methodologies is particularly important for policy-related research but is often too time intensive to provide an accurate current perspective of cannabis policies, given the breadth of variables. This manuscript's purpose is to provide a narrative of policy approaches being taken in state cannabis marketplaces at this time; data should not be used for other research projects.

In conclusion, protecting public health and consumer safety in the face of a rapidly evolving cannabis industry with new products, varied modes of consumption, and a growing commercial marketplace poses regulatory and public health challenges. A careful yet expeditious approach to gather data, expand scientific knowledge, and study policy related to cannabis will be paramount. The National Cancer Institute's sponsorship of this journal supplement is an important step in that direction.

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Data Availability

The data underlying this article are available through public websites of state cannabis statutes and rules, as noted in Table 1. The datasets were derived only from sources in the public domain.

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