

Measuring Cannabis Laws for Public Safety Evaluations

Anne E. Boustead* and George Reicher**

ABSTRACT

In this article, we present a narrative review of how state-level medical and recreational cannabis laws were measured in the scientific literature investigating their effects on public safety outcomes. The goal of this review is two-fold: first, to identify variation in how medical and recreational laws were defined in the evaluation literature, second, to describe whether evaluations that adopted different definitions of medical or recreational cannabis for purposes of their evaluation systematically differed in their findings. We begin with a discussion of medical and recreational cannabis legalization at the state level in the United States, focusing on areas where states took different approaches to crafting and implementing their laws, as well as a review of established methods for rigorously measuring such variation in law.

We then analyze the literature evaluating the impact of these laws on public safety outcomes, especially crime rates and traffic safety. To conduct this analysis, we systematically identify the set of papers evaluating the effects of cannabis laws on public safety outcome. We then abstract how each paper defined the cannabis laws that were the subject of this evaluation. Next, we describe the variation in how cannabis laws were measured across papers and discuss whether papers that adopted different approaches to measuring cannabis laws appear to have obtained different results in their evaluation of the impact of these laws on public safety outcomes. While our results do not tell a clear story about the relationship between measurement of cannabis laws and the outcomes observed in public safety papers, we argue that future research could paint a clearer picture of the impacts of cannabis laws on public safety by constructing variables that construct the variation in cannabis law over time and place. We conclude the paper by discussing the implications of our results both for researchers who seek to conduct evaluations of cannabis laws and decision-makers seeking to use the results of such analyses while crafting cannabis policy in the future.

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INTRODUCTION

Since the first U.S. state-level cannabis law was passed in 1996, both policymakers and the public have debated the effects of cannabis laws on key public safety outcomes. Researchers from a range of disciplines have worked to provide evidence for this debate by evaluating the impact of cannabis legalization on everything from traffic-related fatalities,¹ to crime² and arrests,³ to law enforcement investigations.⁴ These efforts have only intensified as more and more states have experimented with various forms of cannabis laws. This experimentation has varied in ways that can be difficult to capture solely by defining cannabis laws as allowing for medical cannabis, decriminalization, or recreational cannabis. Within each of these broad categories, states have varied in the circumstances under which they allow cannabis use, the mechanisms through which they allow an individual to obtain cannabis, and how strictly they regulate businesses involved in their state cannabis market.⁵ However, it is not clear whether and how studies that have evaluated the effects of cannabis legalization on public safety outcomes have fully accounted for this variation in law, despite the fact that some theoretical and empirical evidence suggesting that how a state crafts and implements their medical or recreational cannabis law could impact cannabis perception and use.⁶

In this article, we present a narrative review of how state-level medical and recreational cannabis laws were measured in the scientific literature investigating their effects on public safety outcomes. The goal of this review is two-fold: first, to identify variation in how medical and recreational laws were defined in the evaluation literature, second, to describe whether evaluations that adopted different definitions of medical or recreational cannabis for purposes of their evaluation systematically differed in their findings. We begin with a discussion of medical and recreational cannabis legalization at the state level in the United States, focusing on areas where states took different approaches to crafting and implementing their laws.

We then analyze the literature evaluating the impact of these laws on public safety outcomes, especially crime rates and traffic safety. To conduct this analysis,

¹ See, e.g., D. Mark Anderson, Benjamin Hansen, & Daniel I. Rees, *Medical Marijuana Laws, Traffic Fatalities, and Alcohol Consumption*, 56 J. LAW & ECON. 333 (2013).

² Yu-Wei Luke Chu & Wilbur Townsend, *Joint Culpability: The Effects of Medical Marijuana Laws on Crime*, 159 J. ECON. BEHAV. AND ORG. 502 (2019).

³ Andrew D. Plunk, et al., *Youth and Adult Arrests for Cannabis Possession After Decriminalization and Legalization of Cannabis*, 173 JAMA PEDIATRICS 763 (2019).

⁴ Henning, Matsuda, & Stewart, *Dazed and Confused: Difficulties for Law Enforcement During Oregon's Transition to a Legal Marijuana Market*, POLICE QUARTERLY 1 (2022).

⁵ For a discussion of the variation in cannabis law, see, e.g., Rosalie Liccardo Pacula, Anne Boustead & Priscillia Hunt, *Words Can Be Deceiving: A Review of Variation Among Legally Effective Medical Marijuana Laws in the United States*, 7 J. DRUG POLICY ANAL. 1 (2014).

⁶ Isaac C. Rhew, et al., *Associations of Cannabis Retail Outlet Availability and Neighborhood Disadvantage with Cannabis Use and Related Risk Factors Among Young Adults in Washington State*, 232 DRUG ALCOHOL DEPENDENCE I (2022).

we systematically identify the set of papers evaluating the effects of cannabis laws on public safety outcome. We then abstract how each paper defined the cannabis laws that were the subject of this evaluation. Next, we describe the variation in how cannabis laws were measured across papers and discuss whether papers that adopted different approaches to measuring cannabis laws appear to have obtained different results in their evaluation of the impact of these laws on public safety outcomes. We conclude the paper by discussing the implications of our results both for researchers who seek to conduct evaluations of cannabis laws and decision-makers seeking to use the results of such analyses while crafting cannabis policy in the future.

I. CANNABIS LEGALIZATION IN THE UNITED STATES

A. *The Early Years*

Cannabis legalization in the U.S. began with the passage of medical cannabis laws, typically through the voter initiative process. California adopted their first medical cannabis law with the passage of Prop. 215 in 1996, and Oregon and Washington followed in 1998 with the passage of Ballot Measure 67 and Initiative 692, respectively. Several more states (including Alaska and Colorado) adopted medical cannabis laws through voter initiatives before Hawaii became the first to adopt medical cannabis legislatively in 2000 with the passage of SB 862 in 2000. By the beginning of 2009, 14 states had adopted medical cannabis laws.

The earliest medical cannabis laws were frequently focused on outlining the circumstances under which an individual could use cannabis for medical purposes, including what medical conditions could serve as the basis for a physician's recommendation and whether an individual must register with the state as a medical cannabis patient prior to being afforded full legal protections for their cannabis use. Notably, early cannabis states often broadly defined the medical conditions for which cannabis use would be medically protected, with several states including an allowance for "severe pain" (without specifying that the pain must originate from a specific disease or injury)⁷ or for "any condition for which marijuana provides relief."⁸ Registry provisions were common in early state laws, although not universal. For example, Colorado Amendment 20 established "an exception from the state's criminal laws for any patient or primary care-giver in lawful possession of a registry identification card to engage or assist in the medical use of marijuana," although it also established an affirmative defense against prosecution for individuals previously diagnosed with a debilitating medical condition, whose physician had indicated that they could benefit from medical cannabis, and who

⁷ A.B. 453 § 6, 2001 Leg., 71st Reg. Sess. (Nev. 2001). *See also* S.B. 791 § 21-28,6-3,2006 Gen. Assemb. (R.I. 2006) (defining "[d]ebilitating medical condition" to include "[a] chronic or debilitating disease or medical condition that produces...severe, debilitating, chronic pain.").

⁸ Compassionate Use Act of 1996, Prop. 215 § 1(b)(1)(A) (Cal. 1996).

possessed an amount of cannabis under the state medical possession limit.⁹ However, even states with registry provisions differed in significant aspects, including the agency responsible for administering the card system¹⁰ and whether the recommendation underlying the request for a medical cannabis card had to originate from a physician with an established or bona fide relationship with the patient.¹¹

Early state medical cannabis laws often—but not always—limited the amount of cannabis that a patient could possess at one time.¹² These laws also allowed patients to obtain cannabis through home cultivation, although they varied somewhat in the amount of cannabis that a patient was allowed to grow at one time. For example, Oregon initially allowed cultivation of 3 mature plants and 4 immature plants;¹³ although they would later increase the amount an individual patient could cultivate to include “up to six mature marijuana plants.”¹⁴ State laws in this era were generally silent on the circumstances under which an individual could cultivate cannabis for their own medical purposes, typically not requiring cultivating patients to engage in behavior to ensure the cannabis was being grown in a secure manner and was not accessible to children.

Patients could also designate a caregiver to assist them with obtaining and using cannabis, although states varied significantly in how they specified the required relationship between the cannabis patient and their caregiver, and whether (and how) they limited the number of patients a caregiver could serve. During this time period, state medical cannabis laws typically described the allowable relationship between patient and caregiver in three ways, with some states simultaneously adopting

⁹ Co. Const. Amend. Art. XX §14(2) (amend. 2001). *See also* Montana Medical Marijuana Act of 2004, Init. No. 148 § 4 (Mont. 2004) and S.B. 76 § 4472(7), 2003 Gen. Assemb. (Vt. 2004). In contrast, California did not establish a registry card system for patients in their state until the passage of S.B. 420 in 2003, and this system was voluntary rather than mandatory. S.B. 420 § 11362.8, 2003 Leg. (Cal. 2003), *See People v. Kelly*, 47 Cal. 4th 1008, 1043 103 Cal.Rptr.3d 733, 222 P.3d 186 (2010) for a discussion of the legal protections for medical cannabis patients established by Prop. 215 and SB 420 respectively.

¹⁰ Compare S.B. 76 § 4473(b), 2003 Gen. Assemb. (Vt. 2003) (establishing the “Department of Public Safety” as the agency that reviewed, verified, and approved/denied applications for a registry card) with Montana Medical Marijuana Act of 2004 § 2(2) Init. No. 148 (Mt. 2004) (establishing the “Department of Public Health and Human Services” as the department who administered the registry card system).

¹¹ S.B. 791, 2023 Gen. Assemb. (R.I. 2023), S.B. 76 § 4472, 2003 Gen. Assemb. (Vt. 2003).

¹² For example, Alaska Ballot Measure 8 (1998) extended legal protections to patients who possessed no more than one ounce of useable cannabis and six cannabis plants (of which three could be mature). Alaska Medical Marijuana Act § 17.38.020, Measure 8 (Alaska 1998).

¹³ Oregon Medical Marijuana Act of 1998, Measure 67 (Or. 1998). *See also Id.* at § 333-008-0080 (allowing “no more than six marijuana plants, with no more than three mature and flowering plants producing usable marijuana at any one time.”).

¹⁴ S.B. 1085 § 9(1)(a), 73rd Leg. Assemb., Reg. Sess. (Or. 2006). California also explicitly allowed their patients to grow no more than 6 mature or 12 immature plants with the passage of SB 420 (2003).

multiple descriptions. First, some states defined caregivers as someone with whom the patient has a specified close relationship such as a family member¹⁵ or a health care proxy.¹⁶ Second, some states defined caregivers as someone who aids the patient with their use of marijuana.¹⁷ Third, and most commonly, some states defined caregivers as someone who has assumed responsibility for the health and welfare of the patient.¹⁸ Some states—particularly those who had adopted broader definitions of caregiver—regulated the number of patients a caregiver could serve,¹⁹ and whether the caregiver could receive compensation for their services.²⁰ Just as patients were often limited in the amount of cannabis they could possess, caregivers were also often subject to limitations on the amount of cannabis they could possess in the course of fulfilling their duties—although states varied on whether these limitations were imposed on an absolute²¹ or a per-patient basis.²² Finally, states that

¹⁵ Legalization of Marijuana for Medical Treatment Initiative of 1998, Init. No. 59 § 6 (D.C. 1998) (“A medical patient may designate or appoint a licensed health care practitioner, parent, sibling, child, or other close relative, domestic partner, case manager/worker, or best friend to serve as a primary caregiver,” where “best friend” is defined very narrowly, to include an individual who is providing intimate medical care to the patient).

¹⁶ L.D. 611, 120th Leg., Reg. Sess. (Me. 2002) amended Maine’s medical marijuana law to specify that a patient’s caregiver must be “named in a written individual instruction or power of attorney for health care” if they were not the patient’s parent or legal guardian.

¹⁷ S.B. 76 § 4472(6), 2003 Gen. Assemb (Vt. 2003) (defining a registered caregiver as someone who “has agreed to undertake responsibility for managing the well-being of a registered patient with respect to the use of marijuana for symptom relief”), Montana Medical Marijuana Act § 2(6)(a), Init. No. 148 (Mt. 2004) (defining caregivers as someone “who has agreed to undertake responsibility for managing the well-being of a person with respect to the medical use of marijuana”).

¹⁸ Compassionate Use Act of 1996 § 11362.5(e), Prop. 215 (Cal. 1996) (defining primary caregiver as someone designated by the patient “who has consistently assumed responsibility for the housing, health, or safety of that person”), SB 862 § 329-A, 20th Leg. (H.I. 2000) (defining primary caregiver as someone who “has significant responsibility for managing the well-being of the qualifying patient”), Oregon Medical Marijuana Act of 1998 § 333-008-0010(7), Measure 67 (Or. 1998) (defining designated primary caregiver as someone “who has significant responsibility for managing the well-being of a person who has been diagnosed with a debilitating medical condition”).

¹⁹ Medical Use of Marijuana Act of 1998, Init. 692 (Wa. 1998) (limiting primary caregivers to “[b]e the primary caregiver to only one patient at any one time”). Similarly, at this time Alaska only allowed a caregiver to care for more than one patient if they were “simultaneously caring for two or more patients who are related to the caregiver by at least the fourth degree of kinship by blood or marriage.” S.B. 94, 21st Leg. (Alaska 1999).

²⁰ Michigan Medical Marihuana Act of 2008 § 4(f), Prop. 1 (Mich. 2008) allowed caregivers to “receive compensation for costs associated with assisting a registered qualifying patient in the medical use of marihuana,” while Montana Marijuana Act of 2004 22 3(4), Init. 148 (Mt. 2004) allowed for “reasonable compensation for services provided to assist with a qualifying patient’s medical use of marijuana.”

²¹ Montana Marijuana Act of 2004 § 4(a), Init. 148 (Mt. 2004) (“A qualifying patient or caregiver is presumed to be engaged in the medical use of marijuana if the qualifying patient or caregiver... is in possession of an amount of marijuana that does not exceed the amount permitted.”).

²² Michigan Medical Marihuana Act of 2008 § 4(a), Prop. 1 (Mich. 2008) (A primary caregiver shall not be subject to arrest “provided that the primary caregiver possesses an amount of marihuana

required patients to register in order to receive full legal protections for their possession and use of medical cannabis typically also required caregivers to obtain registry cards.²³

However, cultivation by individual patients or caregivers can be a burdensome and inefficient mechanism for obtaining cannabis.²⁴ Consequently, during this time, states also began experimenting with more wide-scale distribution mechanisms for medical cannabis. Most notably, CA SB 420 allowed patients and caregivers to “associate...in order collectively or cooperatively to cultivate marijuana for medical purposes.”²⁵ This soon led to the establishment of collectives that operated similarly to storefront dispensaries.²⁶ The California Attorney General released contemporaneous guidance stating that, while “a properly organized and operated collective or cooperative through a storefront may be lawful under California law,” “dispensaries that merely require patients to complete a form summarily designating the business owner as their primary caregiver— and then offering marijuana in exchange for cash ‘donations’—are likely unlawful.”²⁷ Nevertheless, the practice continued, with periodic efforts to shut down these dispensaries only highlighting the broad scope of these business practices. For example, in 2010 the City of Los Angeles sent enforcement letters requiring over 400 dispensaries in the Los Angeles Area to shut down.²⁸

California was by no means the only state to reckon with the spread of dispensaries during a time when their existence was questionable (at best) under state law. In some states, ambiguities in the activities that could be undertaken by

that does not exceed...2.5 sources of usable marihuana for each qualifying patient to whom he or she is connect through the department’s registration process”).

²³ For example, A.B. 453 § 32(1), Leg., 71st Reg. Sess. (Nev. 2001) requires the Department of Agriculture to also provide a card to a patient’s primary caregiver upon approval of the patient’s application; this card is required to enjoy the legal protections established by the law.

²⁴ Karen O’Keefe, *State Medical Marijuana Implementation and Federal Policy*, 16 16 J. HEALTH CARE L. AND POL’Y 39, 48 (2013).

²⁵ S.B. 420 § 11362.775, 2003 Leg. (Cal. 2003).

²⁶ Determining the number and scope of California cannabis dispensaries during this time period is a challenging exercise. Cal NORML compiled contact information for cooperatives throughout the state; archived versions of these listings for the time period can be accessed through the Internet Archive’s Wayback Machine. *See, e.g.*, Cal NORML, *Cannabis Patients’ Cooperatives and Support Groups*, <https://web.archive.org/web/20080123174230/http://canorml.org/prop/cbclist.html> (last accessed Dec. 2023). While over 100 organizations are included in this listing, some are described as operating only through deliveries. Additionally, as businesses had to request inclusion in this listing, this is likely only represents a small proportion of the organizations providing cannabis in California at this time.

²⁷ Edmund G. Brown, *Guidelines for the Security and Non-Diversion of Marijuana Grown for Medical Use*, CAL. DEP’T OF JUST. (2008), https://www.counties.org/sites/main/files/file-attachments/med_marijuana_ag_guidelines.pdf?1344638208 [https://perma.cc/CZ32-RCS2].

²⁸ Suzy Strutner, *Medical Marijuana Dispensaries Ordered by Los Angeles City Council to Shut Down by June*, THE DAILY BRUIN (May 11, 2010, 10:34 PM), <https://dailybruin.com/2010/05/11/medical-marijuana-dispensaries-ordered-los-angeles> [https://perma.cc/SA74-CRJ2].

patients and caregivers were used to justify the establishment of organizations that acted as storefront dispensaries. For example, Michigan Prop. 1 (2008) defined medical use of cannabis to include delivery and transfer of cannabis, leading some to open cannabis dispensaries under an argument that allowing “transfer” of cannabis also allowed “sales” between licensed patients and caregivers,²⁹ until the Michigan Supreme Court put a stop to this practice with their decision in *State v. McQueen* (2013).³⁰ Other state agencies simply acknowledged the opening of dispensaries without taking a stance on their legality. For example, in a statement on their website the Colorado Medical Marijuana Registry states that while current state law was “silent on the issue of dispensaries,” they were “aware that a number of such businesses ha[d] been established across the state.”³¹

Finally, during this time a few states began to explicitly allow for the establishment of organizations to provide for wide-scale production and distribution of cannabis. In 2007, New Mexico enacted SB 523, which allowed for “licensed producers” who would be selected and licensed by the New Mexico Department of Health to “produce, possess, distribute and dispense cannabis.”³²

B. (Conditional) Federal Forbearance and State Policy Response

Initial federal reaction to state experimentation with cannabis legalization was not positive. In February 1997, the Office of National Drug Control Policy released an official statement about the Clinton administration’s response to Proposition 215, warning that federal agencies will continue to aggressively enforce federal drug laws where possible, specifically mentioning potential efforts to “revoke the DEA registrations of physicians who recommend or prescribe Schedule I controlled substances,” takeover cannabis seizures when state and local law enforcement is unable to do so under state law, enforce existing tax laws and “disallow[] expenditures in connection with the illegal sales of drugs,” detect cannabis transported through the mail, and continue drug-free workplace programs for federal employees and contractors.³³ As medical cannabis dispensaries began to pop up in

²⁹ Patrick Barone. *A Brief History of Michigan Marijuana Laws*, Michigan Criminal Defense Law Blog (Dec. 15, 2016), <https://web.archive.org/web/20161221102557/https://www.baronedefensefirm.com/blog/history-and-overview-of-michigans-medical-marijuana-laws/>.

³⁰ In *State v. McQueen*, 493 Mich. 135, 160 828 N.W. 2d 644 (2013), the Michigan Supreme Court agreed that sale of cannabis could be considered medical use, but also held that sales of cannabis between patients was not protected under then-current Michigan law because the seller was transferring the cannabis for the purposes of treating the buyer’s symptoms, rather than their own.

³¹ *Colorado Medical Marijuana Registry Dispensaries*, COLO. DEP’T OF PUB. HEALTH AND ENV’T, <https://web.archive.org/web/20091007070236/http://www.cdph.state.co.us:80/hs/medicalmarijuana/Dispensaries%202.pdf>.

³² S.B. 523 §3(D), 2007 Reg. Sess. (N.M. 2007).

³³ Office of Nat’l Drug Control Pol’y, *Administration Response to Arizona Proposition 200 and California Proposition 215*, 62 CFR 6164 (1997), <https://www.govinfo.gov/content/pkg/FR-1997-02-11/pdf/97-3334.pdf>.

states with various medical cannabis legal regimes, the federal government began to take steps to shut them down. In January 1998, the Department of Justice was granted an injunction to prevent the Oakland Cannabis Buyers' Cooperative from distributing cannabis to individuals with a medical cannabis recommendation.³⁴ Supported by the Supreme Court's holding in *Gonzalez v. Raich* that the Controlled Substances Act's prohibition on cannabis cultivation could be applied to purely intrastate medical cannabis activities without exceeding limitations on Congress' power established by the commerce clause,³⁵ the DEA sent numerous warning letters to cannabis dispensaries—and their landlords—announcing that property used to distribute cannabis in violation of federal law could be seized.³⁶ Federal officials also warned local officials that they could face prosecution for implementing aspects of state and local medical cannabis programs.³⁷

The Obama Administration signaled a departure from hostility towards state medical cannabis laws with the release of the Ogden Memo in 2009. In this memo, Deputy Attorney General David Ogden described new DOJ guidance for cannabis-related prosecutions in states with medical cannabis laws.³⁸ Under this approach, U.S. Attorneys were instructed to “not focus federal resources in [their] States on individuals whose actions are in clear and unambiguous compliance with existing state laws providing for the medical use of marijuana.”³⁹ The memo also provided a list of indications that cannabis activities are not in compliance with state law—and

³⁴ *US v. Oakland Cannabis Buyers' Cooperative*, 532 U.S. 483, 121 S. Ct. 1711, 149 L.Ed.2d 722 (2001). For a broader timeline of cannabis dispensary regulation in Oakland, see *Declaration of Arturo Sanchez in Support of City of Oakland's Reply Re Its Motion To Stay Landlords' "Motion for Order Prohibiting Unlawful Use of Defendant Property" in Related Cases*, City of Oakland v. Eric Holder, No. CV 12-5245 MEJ (N.D. Cal. 2012), <https://web.archive.org/web/20160410175501/https://www.oaklandcityattorney.org/PDFS/Federal%20medical%20cannabis%20case/2012-12-11%2027-4%20Sanchez%20Decl%20ISO%20Motion%20to%20Stay.pdf>.

³⁵ *Gonzalez v. Raich*, 545 U.S. 1, 125 S. Ct. 2195 (2005).

³⁶ *Feds Warn Pot Dispensaries*, MONTEREY HERALD (July 15, 2007, 12:00 AM), <https://www.montereyherald.com/2007/07/15/feds-warn-pot-dispensaries/amp/> [<https://perma.cc/B79T-CEQH>].

³⁷ Karen O'Keefe, *State Medical Marijuana Implementation and Federal Policy*, 16 J. HEALTH CARE L. & POL'Y 39, 49 (2013). Note also that some local officials in California also pushed back against the role that they were expected to play in implementing state medical cannabis laws, with San Diego and San Bernardino officials in particular arguing that the state medical cannabis law was preempted by the CSA. The Fourth District Court of Appeals of California rejected their general preemption argument on standing grounds but held that state law provisions requiring counties to issue medical cannabis patient identification cards were not preempted by the CSA. *County of San Diego v. San Diego NORML*, 165 Cal. App. 4th 798, 81 Cal. Rptr. 3d 461 (2008), see also *Letter from Jonathan K. Renner*, California Deputy Attorney General to Robert D. Tousignant, Deputy Director and Chief Counsel (July 15, 2005), <https://www.aclu.org/legal-document/letter-california-attorney-generals-office-affirming-validity-state-medical-marijuana> [<https://perma.cc/R664-DG38>].

³⁸ David W. Ogden, *Memorandum for Selected United States Attorneys*, THE UNITED STATES DEPT. OF JUSTICE ARCHIVES (Oct 19, 2009), <https://www.justice.gov/archives/opa/blog/memorandum-selected-united-state-attorneys-investigations-and-prosecutions-states> [<https://perma.cc/W6R6-82UY>].

³⁹ *Id.*

therefore may be “of potential federal interest”—including sales to minors, sales of other controlled substances, the presence of firearms, and signs of money laundering.⁴⁰

After the Ogden memo, states continued to experiment with legalizing medical cannabis—and doing so in a way that allowed for dispensaries or analogous distribution mechanisms. New Jersey enacted their first medical cannabis law with the passage of SB 119 in 2010, allowing for state registered “alternative treatment centers” which were authorized to cultivate, manufacture, and dispense cannabis to registered patients and caregivers.⁴¹ Delaware similarly passed SB 17 in 2011, allowing for “registered compassion centers” that were authorized to perform analogous functions.⁴² While some states with previous medical cannabis laws expanded their laws to explicitly allow for dispensaries,⁴³ state medical cannabis laws that allowed for dispensaries or other distribution outlets were still controversial during this time. For example, the Washington State Legislature passed SB 5073 in 2011, which would have developed a system of licensed dispensers and producers to provide cannabis within their state.⁴⁴ However, then-Governor Gregoire vetoed the provisions of this bill that would have allowed for dispensaries and producers—although she did allow provisions related to patient/caregiver collective cultivation to be enacted.⁴⁵

In light of these developments, the Department of Justice updated the guidance provided by the Ogden memo, with the release of the Cole Memos. These memos, signed by Deputy Attorney General James M. Cole, made clear the limitations of the federal government’s willingness to deprioritize federal prosecutions related to medical cannabis activities that were legal under state law. The first Cole memo (Cole I), released in 2011, discussed state laws that “considered or enacted legislation to authorize multiple large-scale, privately-operated industrial marijuana cultivation centers,” before clarifying that such businesses were in violation of federal law and consequently subject to federal prosecution.⁴⁶ The second Cole memo (Cole II), released in 2013, went further to identify specific federal enforcement priorities, including preventing distribution to minors, sales of cannabis

⁴⁰ *Id.*

⁴¹ S.B. 119 § 3, 2009 Gen. Assemb. (N.J. 2009).

⁴² S.B. 17 § 1, 246th Gen. Assemb. (Del. 2011).

⁴³ S.B. 17, 2011 Gen. Assemb. (Vt. 2011), L.D. 1296 § B-7(6), 2011 Leg., 125th Sess. (Me. 2011).

⁴⁴ S.B. 5073 Part VI § 201(5), 2011 Leg., 62nd Sess. (Wash. 2011).

⁴⁵ *Id.* (Describing Governor Gregoire’s explanation of her partial veto).

⁴⁶ James M. Cole, *Memorandum for United States Attorneys*, U.S. DEPARTMENT OF JUSTICE OFFICE OF THE DEPUTY ATTORNEY GENERAL (June 29, 2011), <https://www.justice.gov/sites/default/files/oip/legacy/2014/07/23/dag-guidance-2011-for-medical-marijuana-use.pdf> (hereinafter Cole I).

by gangs and other criminal enterprises, and cannabis-related violence.⁴⁷ Importantly, Cole II also predicated the Department's continued forbearance of actively enforcing federal cannabis law on states taking an active role in regulating the developing medical cannabis market. "The Department's guidance. . . rests on its expectation that states and local governments that have enacted laws authorizing marijuana-related conduct will implement strong and effective regulatory and enforcement systems that will address the threat those state laws could pose to public safety, public health, and other law enforcement interests."⁴⁸ Cole II additionally warns that such state laws must be robustly implemented, and describes characteristics of state laws that would suggest that cannabis activities conducted pursuant to these laws do not implicate federal priorities, including provisions intended to prevent diversion to other states, minimize cannabis access by children, and "replacing an illicit marijuana trade that funds criminal enterprises with a tightly regulated market in which revenues are tracked and accounted for."⁴⁹

Figure 1 below shows changes in key components of U.S. state medical cannabis laws, before and after these federal memos. Following the Ogden and Cole memos, several key aspects of state medical cannabis laws remained unchanged: most states still placed limits on the amount of cannabis an individual patient could possess,⁵⁰ and states commonly established medical cannabis patient and caregiver registries.⁵¹ However, state medical cannabis laws also became markedly more medicalized in several important aspects.⁵² Most notably, states enacting new cannabis laws after these memos were notably more likely to include provisions allowing and regulating dispensaries or dispensary equivalents—and less likely to include provisions allowing home cultivation. Almost every state that enacted a medical cannabis law prior to 2009 allowed for home cultivation when their initial medical cannabis law was passed,⁵³ while almost every state that explicitly allowed for medical cannabis dispensaries did so years after their initial law was passed.⁵⁴ In

⁴⁷ *Memorandum for United States Attorneys*, U.S. DEPARTMENT OF JUSTICE OFFICE OF THE DEPUTY ATTORNEY GENERAL (Aug. 29, 2013), <https://www.justice.gov/iso/opa/resources/3052013829132756857467.pdf> (hereinafter Cole II).

⁴⁸ *Id.* at 2.

⁴⁹ *Id.* at 3.

⁵⁰ For example, North Dakota Measure 5 (2016) defines "[u]sable amount of medical marijuana for medical use" to be less than three ounces of cannabis. N.D. CONST. Measure 5 § 19-24-01(21) (amend. 2016).

⁵¹ For example, S. Act. 6357-E § 3360(11) (N.Y. 2014).

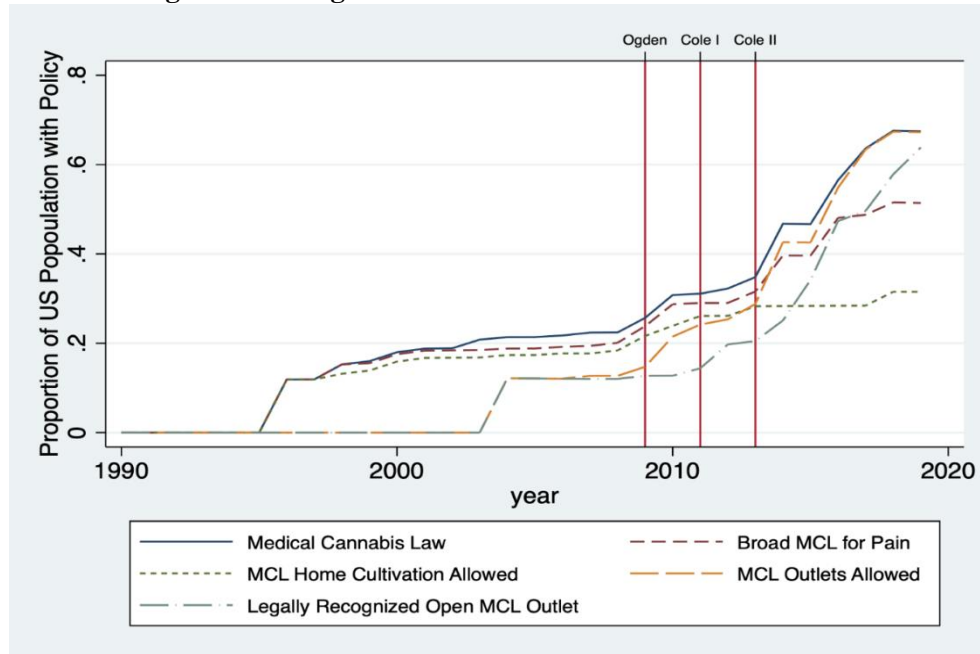
⁵² For a quantitative description of this shift in state law, see Priscillia Hunt, Jeremy N.V. Miles & Anne Boustead, *Understanding Patterns in Medical Marijuana Laws*, 5 (RAND, Working Paper No. WR-1002-NIDA 2013).

⁵³ See, e.g., Compassionate Use Act of 1996, Prop. 215 § 11362.5(d) (Cal. 1996), S.B. 94 § 2(4), 21st Leg. (Alaska 1999), and Montana Medical Marijuana Act, Init. 148 (Mont. 2004). One exception would be H.B. 702, 2003 Leg. (Md. 2003), but their law simply established a medical necessity defense that lowered the punishment for possession to a small fine.

⁵⁴ For example, Vermont initially legalized medical cannabis with the passage of S.B. 76 in 2004 but would not allow medical cannabis dispensaries until the passage of S.B. 17 in 2011, while

contrast, states that began to experiment with medical cannabis legalization after the Cole II was released in 2013 largely allowed for dispensaries in their initial law,⁵⁵ but many did not allow for home cultivation.⁵⁶ States also expanded aspects of their laws related to product safety,⁵⁷ and began to require tracking of cannabis products as they moved through the market from producer to retailer to consumer.⁵⁸

Figure 1: Changes in Medical Cannabis Law Over Time⁵⁹



Colorado initially legalized medical cannabis with the passage of Amendment 20 in 2000 but would not explicitly allow for medical cannabis dispensaries until the passage of SB 10-109 and HB 10-1284 in 2010. *See* S.B. 76, 2003 Gen. Assemb (Vt. 2003), S.B. Gen. Assemb. Reg. Sess. (Co. 2010), H.B. 10-1284 § 12-43.3-310(5), 67th Gen. Assemb. Reg. Sess. (Co. 2010). An exception to this trend is New Mexico, which allowed for “licensed producers” who could dispense cannabis with the passage of their first medical cannabis law, SB 523 (2007). *See* S.B. 523, 48th Gen. Assemb. Reg. Sess. (N.M. 2007).

⁵⁵ For example, H.B. 1 (Ill. 2013) allowed both cultivation and dispensing organizations but did not cultivation in their definition of medical use of cannabis, while Ohio’s first medical cannabis law, H.B. 523 (Ohio 2016), tasked their newly created medical marijuana control program with establishing a licensing system for “retail dispensaries.” *See* H.B. 1 § 10(e), 2013 Gen. Assemb. (Ill. 2013); H.B. 523 § 3796.02, 131st Gen. Assemb. Reg. Sess. (Ohio 2016).

⁵⁶ However, some states that initially did not allow for home cultivation of cannabis did eventually amend their laws to allow such activities, including Illinois with the passage of H.B. 4799 in 2020. *See* H.B. 4799, 102nd Gen. Assemb. Reg. Sess. (Ill. 2020).

⁵⁷ Sarah B. Klieger, *et al.*, *Mapping Medical Marijuana: State Laws Regulating Patients, Product Safety, Supply Chains, and Dispensaries, 2017*, 112 ADDICTION 2206 (2017).

⁵⁸ For example, S.B. 3 § 301(A)(4), 2015 Gen. Assemb. (Pa. 2016).

⁵⁹ The data used to create this chart was derived from the USC RAND Optic Marijuana Law Dataset, and the authors’ review of relevant state laws. RAND-USC Schaeffer Opioid Policy Tools and

Simultaneously, states began to experiment with ways of tying their medical cannabis laws to medical actors or activities. Connecticut's first medical cannabis law, HB 5389 (2012), required that applicants for medical cannabis dispensary licenses must be licensed pharmacists,⁶⁰ and required that licensed producers be able to cultivate "pharmaceutical grade marijuana for palliative use."⁶¹ Connecticut regulations implementing this law further required that dispensaries report information about cannabis orders filled to the state's Prescription Drug Monitoring Program (PDMP), and review a patient's prescription drug monitoring records prior to dispensing cannabis⁶²—analogous to the requirements in many states that pharmacists enter information about opioid prescriptions in their state's PDMP, and that physicians access PDMP records prior to writing opioid prescriptions.⁶³ Similar requirements that medical cannabis disbursement be reported to PDMPs are in effect in a number of other states, including Arizona,⁶⁴ Minnesota,⁶⁵ and Ohio.⁶⁶ Some states also used the density of medical services within their state to benchmark their developing medical cannabis markets. For example, Arizona tied the number of dispensary licenses that could be issued to be no more than 10% of the number of registered pharmacies in the state.⁶⁷

Finally, some states medicalized their medical cannabis laws by creating tighter restrictions around the circumstances under which an individual would be eligible for medical cannabis. In contrast to many early medical cannabis laws—which broadly allowed individuals to obtain medical cannabis recommendations for pain—medical cannabis laws after the Ogden and Cole memos more frequently specified that individuals could obtain medical cannabis for pain under certain, narrower conditions. Sometimes, states did this by requiring that the pain be connected to a

Information Center, *OPTIC-Vetted Medical Marijuana Policy Data*, <https://www.rand.org/health-care/centers/optic/resources/datasets.html> [<https://perma.cc/9TEV-HM73>] (last visited Dec. 2023).

⁶⁰ H.B. 5389 § 9B, 2012 Gen. Assemb. (Conn. 2012).

⁶¹ *Id.* at § 10H.

⁶² F.B. 6131 § 21a-408-38, 2014 Gen. Assemb. (Conn. 2014).

⁶³ Rebecca L. Haffajee, Anupam B. Jena, & Scott G. Weiner, *Mandatory Use of Prescription Drug Monitoring Programs*, 313 JAMA 1, 1 (2015).

⁶⁴ US DEP'T OF JUST., Office of Justice Programs, *Prescription Drug Monitoring Program: Arizona State Profile (2021)*, available at <https://www.ojp.gov/library/publications/prescription-drug-monitoring-program-arizona-state-profile-2021> [<https://perma.cc/3LQX-FE7T>] (last visited Feb. 2023).

⁶⁵ US DEP'T OF JUST., Office of Justice Programs, *Prescription Drug Monitoring Program: Minnesota State Profile (2021)*, <https://www.ojp.gov/ncjrs/virtual-library/abstracts/prescription-drug-monitoring-program-minnesota-state-profile-2021> [<https://perma.cc/7MPD-MCWZ>] (last visited Feb. 2023).

⁶⁶ US DEP'T OF JUST., Office of Justice Programs, *Prescription Drug Monitoring Program: Ohio State Profile (2021)*, <https://www.ojp.gov/ncjrs/virtual-library/abstracts/prescription-drug-monitoring-program-ohio-state-profile> [<https://perma.cc/3CGE-EM89>] (last visited Feb. 2023).

⁶⁷ Arizona Medical Marijuana Act, Prop. 203 § 36-2804 (Ariz. 2010).

diagnosed underlying medical condition supported by extensive evidence.⁶⁸ Other times, states did this by requiring that medical cannabis be used to treat pain only after more standard treatments had tried and failed, or if these treatments would be ill-advised. For example, Arkansas Issue 6 (2016) defined “qualifying medical condition” to include “intractable pain...which is pain that has not responded to ordinary medications, treatment, or surgical measures for more than six (6) months,”⁶⁹ while Pennsylvania SB 3 (2016) defined “serious medical condition” to include “pain in which conventional therapeutic intervention and opiate therapy is contraindicated or ineffective.”⁷⁰ However, as concerns over the opioid crisis intensified, other states shifted their medical cannabis laws to make medical cannabis more available as a substitute for prescription opioids. In 2018, the New York State Department of Health amended their medical cannabis regulations to allow medical cannabis to be recommended under circumstances where patients are in severe pain and would otherwise receive opioids and recognize opioid use disorder as a qualifying condition for which medical cannabis could be recommended.⁷¹

C. Decriminalization and Recreational Legalization

States have explored cannabis decriminalization—the shifting of penalties for cannabis possession from a felony to an infraction punishable by a small fine similar to a traffic ticket—for decades.⁷² Proponents of these policies have argued that decriminalization will reduce costs associated with enforcing cannabis prohibition and punishing those in possession of small amounts of cannabis,⁷³ as well as prevent the substantial ancillary costs an individual experiences when they are arrested and convicted—costs that, in the case of cannabis, have been disproportionately borne

⁶⁸ For example, in 2008, the New Mexico Department of Health defined “debilitating medical condition” to include any approved medical condition “which results in pain, suffering or debility for which there is credible evidence that medical use of marijuana could be of benefit.” N.M. Code §7.34.2 (2008). However, in 2010 they updated their regulation to specify that individuals seeking approval to qualify as a medical patient because of severe chronic pain must be able to show objective evidence of the source of the pain and provide two recommendations (one from their primary care physician and one from a specialist) specifying that they have “an unremitting severe chronic pain condition.” N.M. Code §7.34.3 (2010).

⁶⁹ Arkansas Medical Marijuana Amendment of 2016, Issue 6 § 2(13)(B), 2017 Gen. Assemb. (Ark. 2016).

⁷⁰ S.B. 3 § 301(1)(16), 2015 Gen. Assemb. (Pa. 2016).

⁷¹ NEW YORK STATE DEP’T OF HEALTH, *New York State Department of Health Announces Opioid Replacement Now a Qualifying Condition for Medical Marijuana* (July 12, 2018), https://www.health.ny.gov/press/releases/2018/2018-07-12_opioid_replacement.htm [<https://perma.cc/VG96-Q2QS>].

⁷² Rosalie Liccardo Pacula, Jamie F. Chriqui, & Joanna King, *Marijuana Decriminalization: What Does It Mean in the United States?*, § VI (NBER, Working Paper No. 9690, 2003).

⁷³ James Austin, *Rethinking the Consequences of Decriminalizing Marijuana*, PRISON POLICY REPORT, 1, 2, https://www.prisonpolicy.org/scans/jfa/marijuana_report.pdf.

by people of color.⁷⁴ In the course of reducing the penalties in place for small quantities of cannabis, state decriminalization laws may differentiate between possession of different types of cannabis. For example, California's decriminalization law reduced the penalty for possession of under 28.5 grams of non-concentrated cannabis to a fine of not more than \$100, but set the penalty for possession of concentrated cannabis to not more than 1 year in prison and/or a fine of not more than \$500.⁷⁵

In 2012, Colorado and Washington became the first states to legalize recreational cannabis with the passage of Amendment 64 and Initiative 502 respectively. As of 2023, 18 other states and Washington D.C. have passed recreational legalization measures. The earliest cannabis legalization efforts were enacted through ballot initiatives and other forms of direct democracy, increasingly used mechanisms through which voters can directly enact legislation or state Constitutional amendments.⁷⁶ States have continued to pass recreational cannabis laws through their voter initiative processes.⁷⁷ Vermont would become the first state to legalize recreational cannabis through their state legislature in 2018 with the passage of Act 86,⁷⁸ a limited recreational cannabis law that allowed supply only through home cultivation.⁷⁹ Illinois soon passed HB 1438 in 2019, becoming the first state to pass a law regulating and taxing recreational cannabis sales through the legislature.⁸⁰ Since then, New York,⁸¹ Virginia,⁸² New Mexico,⁸³ Connecticut,⁸⁴ and Rhode Island⁸⁵ have all passed recreational cannabis laws through their state legislatures.

Figure 2 below shows variation in state recreational cannabis laws—and their components—over time. Notably, most states that legalized recreational cannabis simultaneously allowed for and regulated a licensed retail market for selling these

⁷⁴ Beverly Yuen Thompson, "Good Moral Characters:" How Drug Felons are Impacted Under State Marijuana Legalization Laws, 20 CONTEMP. JUST. REV. 211, 212 (2017).

⁷⁵ S.B. 1449 § 1, 2010 Gen. Assemb. (Cal. 2010).

⁷⁶ John G. Matsusaka, *Direct Democracy Works*, 19 J. ECON. PERSP. 185, 190 (2005). In fact, many policy innovations were originally passed through direct democratic processes, "including term limits, physician-assisted suicide, legalized gambling, medical marijuana, capital punishment, abortion, racial preferences/affirmative action and, of course, tax cuts." *Id.* at 185.

⁷⁷ For example, Arizona legalized recreational cannabis through the passage of Proposition 207 in 2020. S.B. 1466, 46th Leg. 1st Reg. Sess. (Ariz. 2020).

⁷⁸ An act related to eliminating penalties for the possession of limited amount of marijuana by adults 21 years of age or older. H.B. 511, 2018 Gen. Assemb. (Vt. 2018).

⁷⁹ *Id.* at § 7. Vermont would not allow commercial cultivation of cannabis until the passage of Act 164 in 2020.

⁸⁰ Cannabis Regulation & Tax Act, H.B. 1438 § 1-5(a), 2019 Leg. (Ill. 2019).

⁸¹ Marihuana Regulation and Taxation Act, S.B. 854A § 1, 2021-2022 Reg. Sess. (N.Y. 2021).

⁸² H.B. 2312 § 2.2-2499.1, 2021 Reg. Sess. (Va. 2021).

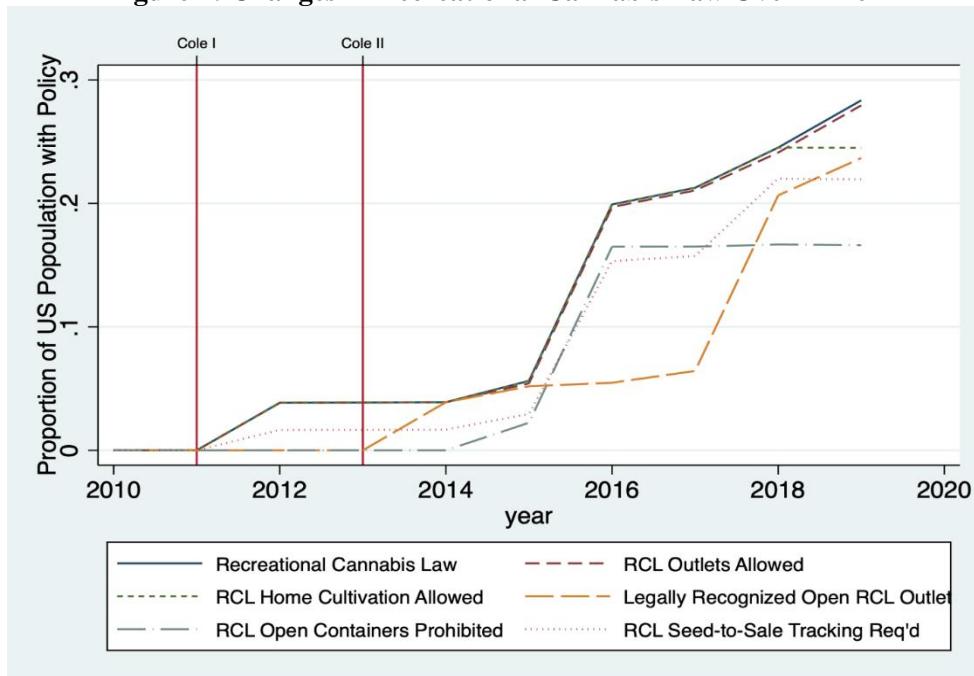
⁸³ H.B. 2, 55th Leg., 2021 Special Sess. (N.M. 2021).

⁸⁴ H.B. 1201, 2021 Special Sess. (Conn. 2021).

⁸⁵ A.D. 2430, 2022 Gen. Assemb. (R.I. 2022).

products direct to consumers. Some states created specialized agencies to oversee their cannabis market (such as the Bureau of Cannabis Control in California⁸⁶), while other states assigned regulatory authority to an existing state agency (such as the Illinois Department of Financial and Professional Regulation⁸⁷). In response to concerns that communities of color disproportionately targeted in drug enforcement efforts were also being shut out of the legal cannabis market,⁸⁸ several states have chosen to intentionally design their recreational cannabis legislation to facilitate participation by underrepresented populations. For example, New York’s Marihuana Regulation and Taxation Act (2021) explicitly requires their regulatory agency to “prioritiz[e] consideration of applications by applicants who are from communities disproportionately impacted by the enforcement of cannabis prohibition.”⁸⁹

Figure 2: Changes in Recreational Cannabis Law Over Time⁹⁰



⁸⁶ DEP’T OF CANNABIS CONTROL, *About the Department of Cannabis Control*, <https://cannabis.ca.gov/about-us/about-dcc/> [<https://perma.cc/F393-XEJD>] (last visited July 2023).

⁸⁷ ILL. DEP’T OF FIN. AND PRO. REGUL., *Adult Use Cannabis Program*, <https://idfpr.illinois.gov/profs/adultusecan.html> [<https://perma.cc/BHW8-CGCU>] (last visited July 2023).

⁸⁸ Mathew Swinburne and Kathleen Hoke, *State Efforts to Create an Inclusive Marijuana Industry in the Shadow of the Unjust War on Drugs*, 15 J. BUS. & TECH. L. 235, 255 (2020).

⁸⁹ S.B. 854A § 87, 2021-2022 Reg. Sess. (N.Y. 2021).

⁹⁰ The data used to create this chart was derived from the USC RAND Optic Marijuana Law Dataset, the Alcohol Policy Information System’s Recreational Cannabis Policy Dataset, and the authors’ review of relevant state laws. RAND-USC Schaeffer Opioid Policy Tools and Information

States that legalized recreational cannabis substantially varied in the amount of time between the passage of their law and beginning of legal recreational cannabis sales. In some cases, this implementation process took a substantial period of time: the first legal recreational cannabis sales took place in Colorado in January 2014, more than a year after their recreational cannabis law was passed,⁹¹ and almost four years passed between the enactment of a recreational cannabis law and the first legal sales in Maine.⁹² In contrast, recreational cannabis sales began in Arizona less than three months after the passage of Proposition 207.⁹³

States have also diverged in how they regulate their legal cannabis market. Many states—including Nevada⁹⁴ and Massachusetts⁹⁵—have now implemented seed-to-sale monitoring of their legal cannabis supply, allowing them to track cannabis “from its very infancy to the point where it’s sold over the counter.”⁹⁶ States also commonly limit advertising by cannabis businesses, especially when advertisements may be viewable by those under the age of 21, although the contours of these limitations vary by state. According to a recent analysis by the Network for Public Health Law, while 16 states with recreational cannabis laws restrict advertising, only 13 of them restrict broadcast advertising and only 6 regulate safety claims by advertisers.⁹⁷ Furthermore, just as some states experimented with regulating packaging of medical cannabis products, states have also experimented with regulating packaging of recreational cannabis products. For example, Arizona

Center, *OPTIC-Vetted Medical Marijuana Policy Data*, <https://www.rand.org/health-care/centers/optic/resources/datasets.html> (last visited Dec. 2023); Alcohol Policy Information System, *Cannabis Policy Topics*, <https://alcoholpolicy.niaaa.nih.gov/apis-policy-topics> (last visited Dec. 2023).

⁹¹ John Ingold, *World’s First Legal Recreational Marijuana Sales Begin in Colorado*, DENVER POST (Jan. 1, 2014, 12:27 AM), <https://www.denverpost.com/2014/01/01/worlds-first-legal-recreational-marijuana-sales-begin-in-colorado/> [<https://perma.cc/5FJD-XVJ3>].

⁹² Brad Rogers, *Recreational Marijuana Has a Big Year in Maine, Sales Nearly Double in 2022*, WGME (Jan. 10, 2022, 6:19 PM), <https://wgme.com/news/local/recreational-marijuana-big-year-maine-sales-double-2022-cannabis-pot-weed-medical-rose-mary-jane-grass-roots> [<https://perma.cc/TCC4-MVFJ>].

⁹³ Solomon Israel, *Recreational Marijuana Sales Kick Off in Arizona Less Than Three Months After Voters Pass Ballot Measure*, *MBIZDAILY* (Jan. 22, 2021), <https://mbizdaily.com/recreational-marijuana-sales-begin-in-arizona/> [<https://perma.cc/BZQ9-RZ58>].

⁹⁴ CANNABIS COMPLIANCE BOARD STATE OF N.V., *Metrc Industry Bulletins*, <https://ccb.nv.gov/guidance/> [<https://perma.cc/C7T8-AGMH>] (last visited July 2023).

⁹⁵ CANNABIS CONTROL COMM’N MASS, *Seed-to-sale Tracking*, <https://masscannabiscontrol.com/seed-to-sale-tracking/> [<https://perma.cc/6WEK-FWQK>] (last visited July 2023).

⁹⁶ Ben Miller, *Making It Legal: The Tech Implications of Regulating Recreational Marijuana* (Mar. 2017), <https://www.govtech.com/policy/making-it-legal-tech-implications-of-regulating-recreational-marijuana.html> (last visited July 2023) [<https://perma.cc/X3JX-JC8U>].

⁹⁷ Mathew R. Swinburne & Simon Liu, *State Regulation of Adult Use Cannabis Advertising*, The Network for Public Health Law (Sept. 20, 2022), <https://www.networkforphl.org/wp-content/uploads/2022/11/State-Regulation-of-Adult-Use-Cannabis-Advertising.pdf> [<https://perma.cc/CD4A-X52F>].

Prop. 207 requires marijuana packaging to not resemble a toy or cartoon or be given a name “that resemble[s] or imitate[s] food or drink brands marketed to children.”⁹⁸

States with recreational cannabis laws generally enact specific prohibitions against driving while under the influence of cannabis. However, states have differed in the level of detail they have provided regarding how driving under the influence of cannabis should be identified, which is particularly salient given current difficulties in establishing cannabis intoxication in a roadside setting.⁹⁹ While states often do not specify a specific standard for establishing cannabis intoxication,¹⁰⁰ others—including Illinois¹⁰¹—establish a specific level of THC concentration within blood or other bodily fluids that will demonstrate per se cannabis intoxication. States have also experimented with additional mechanisms for reducing harms associated with driving under the influence of cannabis, such as a prohibition on open containers in the passenger compartments of cars, over time as their recreational cannabis laws were implemented.¹⁰²

Recreational cannabis laws are sometimes called “adult-use” cannabis laws, as they legalize cannabis activities by those over the age of 21. Correspondingly, recreational cannabis laws generally include provisions limiting cannabis activities by those under the age of 21. However, the structures of these limitations and the punishments available for violating them does vary somewhat from state-to-state.¹⁰³ For example, Vermont punishes possession of less than an ounce of cannabis by a person between the ages of 16 and 21 with either participation in a diversion program or a small civil penalty,¹⁰⁴ while Washington considers possession, manufacturing, or sales of cannabis by a person under the age of 21 to be a misdemeanor.¹⁰⁵

II. NARRATIVE REVIEW OF CANNABIS LAW MEASUREMENT IN PUBLIC SAFETY EVALUATIONS

The broad variation in cannabis law—both over time and between states raises a set of conspicuous questions. First, how has the public safety literature

⁹⁸ A.R.S. § 36-2860 (2020).

⁹⁹ Ed Wood, Ashley Brooks-Russell, & Phillip Drum, *Delays in DUI blood testing: Impact on cannabis DUI assessments*, 17 *Traffic Injury Prevention* 105 (2016).

¹⁰⁰ For a summary of state cannabis impaired driving laws, see Alcohol Policy Information System, *Recreational Use of Cannabis: Volume 1*, <https://alcoholpolicy.niaaa.nih.gov/cannabis-policy-topics/recreational-use-of-cannabis-volume-1/104> (last visited July 2023) [<https://perma.cc/8KV5-656Q>].

¹⁰¹ 625 *Ill. Comp. Stat.* 5/11-501.2(a) (2022).

¹⁰² For example, California has banned drivers from having “a receptacle containing cannabis or cannabis products...which has been opened or has a seal broken, or loose cannabis flower not in a container.” CAL. VEH. CODE § 23222(b) (2023).

¹⁰³ For a summary of underage cannabis prohibitions, see Alcohol Policy Information System, *supra* note 100.

¹⁰⁴ VT. STAT. ANN. tit. 18 § 4230(b) (2020).

¹⁰⁵ WASH. REV. CODE § 69.50.4013 (2023).

operationalized and measured cannabis laws in the process of evaluating them? Second, have the outcomes of these evaluations differed across different operationalizations of cannabis laws?

In this section, we attempt to answer these questions. We begin by describing our methods for reviewing the operationalization of cannabis laws in the public safety evaluation literature. We then discuss how cannabis laws have been measured in the public safety literature, paying particular attention to which aspects of cannabis law authors have considered. As the content of cannabis laws has changed over time, we then consider the years of data included in the papers we review. After that, we discuss the consequences of how cannabis laws have been operationalized for the public safety literature, and in particular, whether papers that adopt different methods of measuring cannabis laws differ in their findings.

A. *Methods*

Our first step in reviewing how the public safety evaluation literature has defined and measured cannabis laws was to decide upon what types of papers should be considered within the scope of this project. Although public safety is a broad concept that could in theory include a number of topics related to crime, policing, traffic accidents, economic risk, and public health, for purposes of this project we decided to define public safety narrowly to include subjects related to crime (including both reported crimes and arrests for property and violent crimes), interpersonal violence (including domestic violence, intimate partner violence, and child abuse/neglect), and harms related to driving under the influence (including DUI arrests, traffic accidents, and traffic fatalities). Because we were interested in cannabis law operationalization in the context of evaluating the effects of these laws on public safety outcomes, we also limited the scope of papers we would consider to only those that were conducting quasi-experimental or other quantitative analyses using variation in laws across states as their treatment variable. Significantly, this meant we did not consider papers that only considered the effects of one state's law (for example, the impact of California Proposition 215), since the authors of such a paper would not have to make comparisons across laws in different jurisdictions. Finally, as legal regimes can vary substantially across countries, we limited ourselves only to papers reporting analyses done in the U.S. context.

After making these decisions, we developed a search string that we believed best captured the scope of papers that we wanted to consider for this project.¹⁰⁶ We

¹⁰⁶ This search string was: (marijuana OR marihuana OR cannab* OR pot OR weed OR THC) and (medical OR nonmedical OR recreat* OR "adult-use" OR decrim* OR policy OR policies OR liberal* OR law OR legal*) and (crim* OR driving OR traffic OR arrest* OR robber* OR burgl* OR assault* OR rape* OR homicid* OR murder* OR "domestic violence" OR "intimate partner violence" OR "child abuse" OR "child neglect") AND (eval* OR analysis OR quasiexperiment* OR quasi-experiment* OR "quasi experimental" OR "quasi experiment") AND ("United States" OR US OR Americ* OR state* OR county OR counties OR city OR cities).

then ran this search in a number of databases of scholarly articles,¹⁰⁷ limiting our search to the article abstracts to return articles that focused on the topic of our study (as opposed to, say, an article that discussed a study meeting our criteria in their literature review). This search returned 328 results across databases, which we then reviewed for relevance and to ensure that they met the criteria of our project. This review process resulted in the identification of 18 papers. Separately, we also conducted a traditional literature review for papers evaluating the impact of cannabis laws on public safety outcomes, identifying a further 4 papers for consideration, leading to a total of 22 papers for analysis. A complete list of papers analyzed in this study is available in Appendix A.

Once we had identified the papers we wanted to consider for our project, we then retrieved full text copies of each paper. After a preliminary review of the studies, we decided upon a list of characteristics we wanted to capture, and criteria for appropriately describing each characteristic. Because we were interested in providing a narrative overview and discussion—rather than a formal systematic review¹⁰⁸—this review process focused on providing descriptions of each paper along each characteristic rather than reducing each characteristic to a finite set of dimensions using a numeric coding scheme, although we also reduced some characteristics to a discrete set of codes in order to provide some broad descriptive statistics. Each author independently reviewed each paper under consideration, and we discussed our individual findings until we reached consensus.

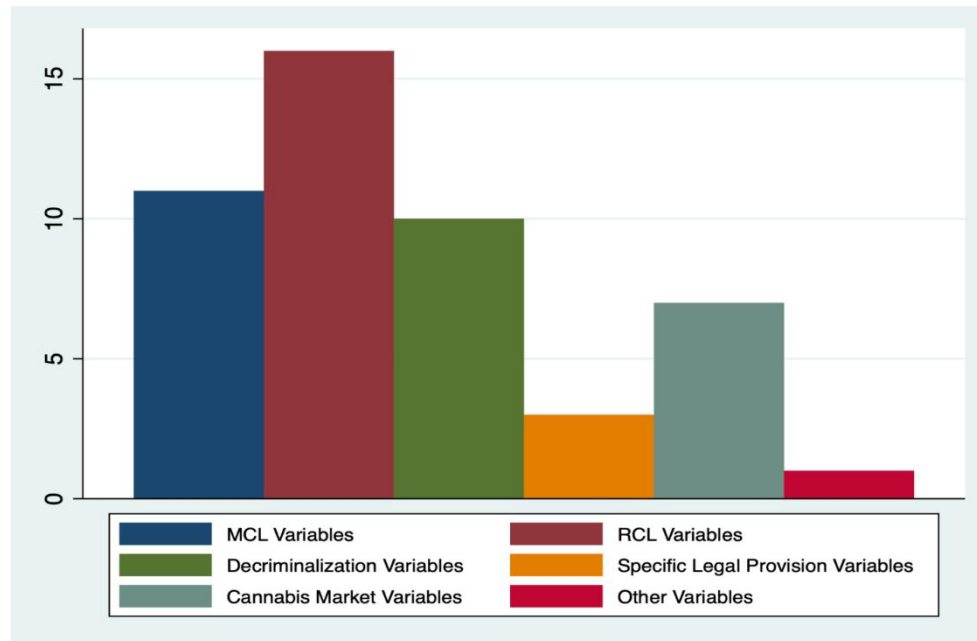
B. Description of Cannabis Law Variables

As is shown in Figure 3 below, of the 22 papers we reviewed for this study, 11 considered medical cannabis laws, 16 considered recreational cannabis laws, and 10 considered cannabis decriminalization.¹⁰⁹

¹⁰⁷ To do this, we used EBESCOhost, which allows searches to be run in multiple databases at the same time. We broadly selected databases that we thought might contain articles of interest for this project, including Academic Search Ultimate, MEDLINE, APA PsycINFO, Global Health, EconLit, ERIC, Political Science Complete, and APA PsycArticles.

¹⁰⁸ For a description of the characteristics of a systematic review, see Edoardo Aromataris & Alan Pearson, *The Systematic Review: An Overview*, 114.3 AM. J. NURSING 53 (2014).

¹⁰⁹ As a paper could consider the effects of multiple types of laws (e.g., medical and recreational cannabis laws), these categories are not mutually exclusive.

Figure 3: Types of Cannabis Law Variables

The papers we reviewed for this process often define these key legal variables without an explicit discussion of what would characterize a particular law as meeting the requirements for a medical cannabis law, a recreational cannabis law, or a decriminalization law. For example, Kaplan and Goh (2022)¹¹⁰ studied the effects of “decriminalization and medical legalization of marijuana” and Windle, Eisenberg, *et al.* (2021) studied the effects of “legalized recreational cannabis and no legalized recreational cannabis.”¹¹¹ However, some papers gave more specific consideration to what characteristics a law should include in order to be considered a cannabis law. Seveigny’s (2018) main medical cannabis variable “codes state laws that extend legal protections to medical marijuana patients (whether through exemption from arrest/prosecution or an affirmative defense).”¹¹² Sheehan, Grucza, and Plunk (2021) considered their decriminalization and legalization policies as turning on when the penalty for using cannabis changed.¹¹³

¹¹⁰ Jacob Kaplan & Li Sian Goh, *Physical Harm Reduction in Domestic Violence: Does Marijuana Make Assaults Safer?*, 37 J. INTERPERSONAL VIOLENCE NP5269, NP5275 (2022).

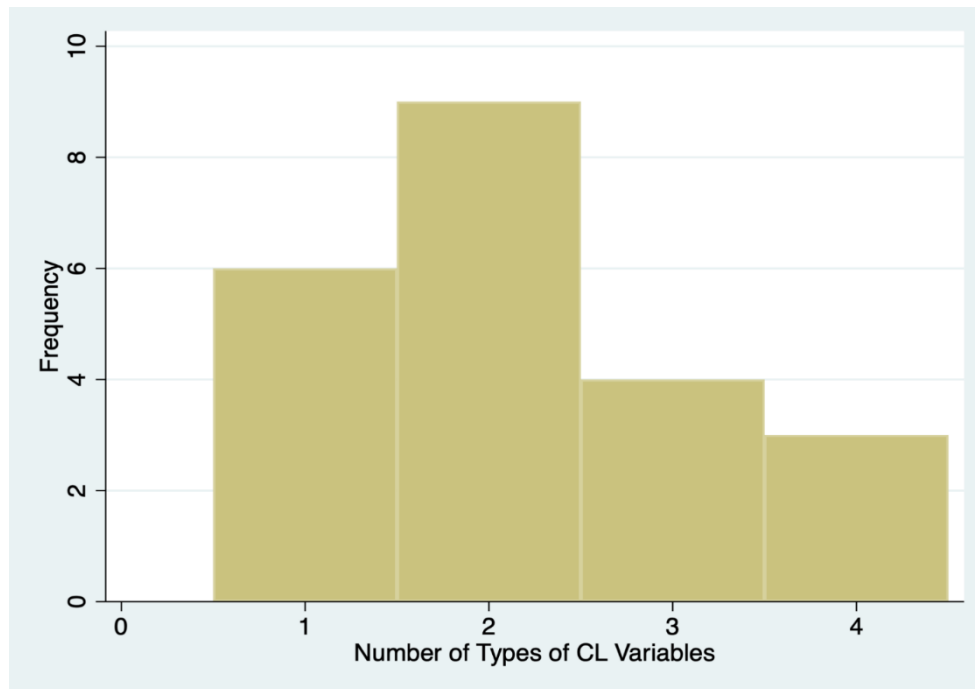
¹¹¹ Sarah B. Windle, *et al.*, *Association between legalization of recreational cannabis and fatal motor vehicle collisions in the United States: an ecologic study*, 9 CMAJ OPEN E233, E234 (2021).

¹¹² Eric L. Seveigny, *The effects of medical cannabis laws on cannabis-involved driving*, 118 ACCIDENT ANALYSIS AND PREVENTION 57, 58 (2018).

¹¹³ Brynn E. Sheehan, Richard A. Grucza, & Andrew D. Plunk, *Association of Racial Disparity of Cannabis Possession Arrests Among Adults and Youths with Statewide Cannabis Decriminalization and Legalization*, 2021 JAMA HEALTH F.e213435, e213438 (2021).

Many of the papers that we analyzed considered the three main categories of cannabis law—medical, decriminalization, and recreational—simultaneously, although how they did so differed substantially in some cases. Figure 4 below shows a histogram of the number of types of cannabis variables included in these papers. Many papers—including Calverty and Erickson (2020)—included separate variables for medical, decriminalization, and/or recreational cannabis laws, and then presented results for all law types they included in their analysis. Other papers, especially those that were conducted using data immediately after states began legalizing recreational cannabis—focused primarily on understanding the impact of one type of cannabis law, but included variables accounting for other types of cannabis laws and controls.¹¹⁴ A few papers limited their analyses to ensure that all the jurisdictions in their sample had similar cannabis laws in place in the beginning of their study period, to more clearly understand the impact of changing legal regimes.¹¹⁵

Figure 4: Count of Cannabis Law Variables Per Paper



¹¹⁴ For an example, see Yu-Wei Luke Chu & Wilbur Townsend, *Joint culpability: The effects of medical marijuana laws on crime*, 159 J. ECON. BEHAV. AND ORG. 502 (2019).

¹¹⁵ Amanda C. Cook, Gregory Leung, & Rhet A. Smith, *Marijuana Decriminalization, Medical Marijuana Laws, and Fatal Traffic Crashes in US Cities, 2010-2017*, 110 AM. J. PUB. HEALTH 363, 364 (2020).

Some papers went further to consider specific provisions of cannabis laws in their analyses. In particular, Seveigny (2018) considered not only whether a state had a medical cannabis law, but also whether the laws in place allowed for home cultivation and dispensaries (both legal and quasi-legal).¹¹⁶ Dewey, Kindle, *et al.* (2021) used not only a binary measure denoting medical cannabis legalization, but also “a continuous measure of its permissiveness” developed using a joint correspondence analysis.¹¹⁷

Other authors used direct measures of the cannabis market as a complement for variables describing cannabis laws. For example, Santaello-Tenorio, Mauro, *et al.* (2017) looked at the presence of operational cannabis dispensaries in addition to considering state medical cannabis laws.¹¹⁸ Matthay, Kiang, *et al.* (2021) developed a 5-point categorical variable to account for the presence of both medical and recreational cannabis laws, with and without open dispensaries.¹¹⁹ However, one important limitation is that, because our research question is primarily interested in how the literature has defined cannabis laws—and, accordingly, the search strategy we used to identify the papers analyzed in this study was designed to return only papers that included cannabis laws as key variables—we did not consider papers that focused entirely on the impact of legal cannabis markets directly on public safety outcomes.¹²⁰

Finally, the papers under consideration in this study generally used the effective dates of laws as the starting point for switching legal variables on. For example, Chu and Townsend (2019) created a medical cannabis variable that was “a binary indicator equal to one if states had a medical marijuana law in effect in effect in year *t* and zero otherwise”¹²¹ Some papers appeared to use effective dates in creating their

¹¹⁶ Seveigny, *supra* note 112, at 58.

¹¹⁷ Jim Dewey *et al.*, *State Marijuana Laws and Traffic Fatalities*, 51 REV. OF REG’L STUD 246, 252 (2021).

¹¹⁸ Julian Santaella-Tenorio *et al.*, *US Traffic Fatalities, 1985-2014, and Their Relationship to Medical Marijuana Laws*, 107 AM. J. PUB. HEALTH 336, 337 (2017).

¹¹⁹ Elliot C. Matthay, *et al.*, *Evaluation of State Cannabis Laws and Rates of Self-harm and Assault*, 2021 JAMA NETWORK OPEN e211955, 3 (2021) (“We classified each state and month based on the type of law (medical or recreational) and the availability of dispensaries (commercialization)...States without dispensaries were those that permitted only homegrown cannabis or planned to permit dispensaries but had not yet implemented sales.”).

¹²⁰ In fact, there is a broader literature on this point, although it is outside the scope of the current research. For examples of this literature, *see* (among others) Lorine A. Hughes, Lonnie M. Schaible, & Katherine Jimmerson, *Marijuana Dispensaries and Neighborhood Crime and Disorder in Denver, Colorado*, 37 JUST.Q 461 (2020), Nancy J., Kepple & Bridget Freisthler, *Exploring the Ecological Association Between Crime and Medical Marijuana Dispensaries*, 73 J. STUD. ALCOHOL DRUGS 523 (2012), Nathan Connealy, Eric Piza, & Dave Hatten, *The Criminogenic Effect of Marijuana Dispensaries in Denver, Colorado: A Microsynthetic Control Quasi-Experiment and Cost-Benefit Analysis*, 31 JUST. EVALUATION, J. 69 (2020).

¹²¹ Chu, *supra* note 114 at 505.

variables, but were not explicit about this choice.¹²² Other papers used the enacted date of laws in creating their primarily legal variables, using legal variables created using effective dates for sensitivity analysis.¹²³ Papers sometimes described their legal variables as being based on “implementation” of the law; however, there were inconsistencies across papers in what was meant by implementation,¹²⁴ and papers sometimes used implementation¹²⁵ and effective dates interchangeably without discussing potential differences between the two.¹²⁶ Most notably, the decision to define legal variables based on enacted dates, effective dates, or implementation dates was rarely discussed, despite the fact that in practice these dates can, and have, differed substantially.

C. Cannabis Law Eras Under Consideration

As cannabis laws changed substantially over time, on the whole the characteristics of the laws in place will depend on the years of data included in the study. Figure 5 below shows the years of data analyzed for each paper in our study that considered the effects of medical cannabis legalization. About half of these papers included extensive data prior to the first medical cannabis law being passed in 1996; this is a common practice in the evaluation literature as popular quasi-experimental techniques¹²⁷ frequently use pre-treatment data to more accurately parse out the effect (if any) of the treatment. On average, papers that included data prior to the first medical cannabis law included seven years of data prior to the first medical cannabis law. Eight papers included data prior to the release of the Ogden Memo; on average, these papers included 16.5 years of data pre-Ogden Memo. All but two papers included data after the release of the Cole II Memo; on average, these papers included 2.8 years of data post-Cole II Memo.

¹²² See Hamzeie, Thompson, et al., *State-Level Comparison of Traffic Fatality Data in Consideration of Marijuana Laws*, 2660 *TRANSP. RSCH. REC* 78, 80-81 (2017). Here the authors mentioned that they collected “information about the state laws governing cannabis, as well as they year such laws went into effect”, suggesting but not explicitly stating that the effective date of the law was used to create the legal variable.

¹²³ Santaella-Tenorio, et al., *supra* note 118 at 337. (“States enacting medical marijuana laws were coded as ‘before’ for the years before the enactment of the laws, and as ‘after’ for the years after. . .”We also used the dates when MMLs became effective, when the statutory obligation commences in each state.”

¹²⁴ Compare Andrew D. Plunk et al., *Youth and Adult Arrests for Cannabis Possession After Decriminalization and Legalization of Cannabis*, 173 *JAMA PEDIATRICS* 763 (2019) with Dewey, et al., *supra* note 115.

¹²⁵ For a description of the policy implementation process, see Thomas B. Smith, *The Policy Implementation Process*, 4 *POL’Y SCI* 197 (1973).

¹²⁶ Plunk, et al., *supra* note 122, at 764.

¹²⁷ Most notably, this is a common practice for difference-in-differences analysis, which is considered one of the main workhorse models in quasi-experimental policy evaluation. Coady Wing, Kosali Simon, & Ricardo A. Bello-Gomez, *Designing Difference in Difference Studies: Best Practices for Public Health Policy Research*, 39 *ANN. REV. OF PUB. HEALTH* (2018).

Figure 5: Years of Data Included in Papers that Considered Medical Cannabis Laws

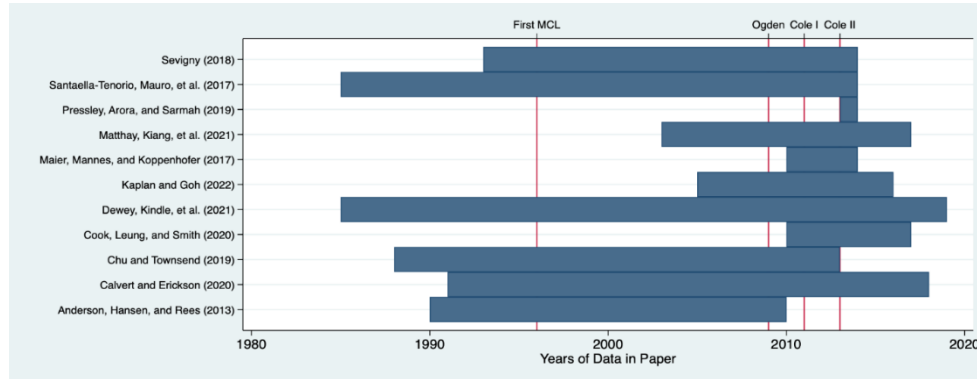
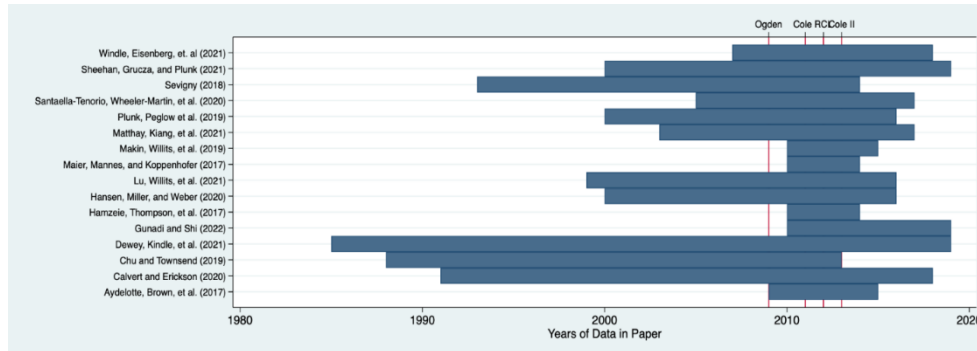


Figure 6 below shows the years of data analyzed for each paper in our study that considered the effects of recreational cannabis legalization. Each of these papers included data prior to the passage of the first recreational cannabis laws in 2012; on average, each paper in this group included 10.75 years of data prior to the first recreational cannabis law. Twelve papers included data prior to the Ogden Memo; these papers included on average 10.6 years of data pre-Ogden Memo. All but one paper included data after the release of the Cole II memo; these papers included on average 3.5 years of data after the release of the Cole II memo.

Figure 6: Years of Data Included in Papers that Considered Recreational Cannabis Laws



In many cases, the years of data chosen to be included in the analysis seems to be driven in large part by the years of outcome data available to conduct the study.¹²⁸ In other cases, the selection of the starting and stopping year for the study were not

¹²⁸ For example, Matthay, et al., *supra* note 119, selected the years for their study based on the availability of the insurance claims dataset they used as outcome data.

both discussed.¹²⁹ However, Cook, Leung, and Smith explicitly limited the time period they studied to exclude any data prior to 2010, as “the US marijuana market changed significantly following the 2009 Ogden Memorandum.”¹³⁰

D. Outcomes Under Consideration

11 of the papers that we reviewed considered the effects of cannabis law on traffic related outcomes (especially fatal car accidents and traffic fatalities), five considered the effects of cannabis law on arrests, four considered the effects of cannabis law on crime rates, and five considered the effects of cannabis law on other public safety outcomes. These other public safety outcomes were frequently used to draw a more complete picture of the impact of cannabis legalization on a more common public safety outcome. For example, Gurucza, Vuolo, *et al.* considered the effects of decriminalization on both cannabis use and cannabis possession arrests.¹³¹ However, some papers did consider unique public safety outcomes. In particular, Makin, Willits, *et al.* (2019) considered the impact of cannabis legalization on crime clearance rates, under the argument that “legalization will allow police to reallocate resources away from possession arrests to the prevention of property and violent crimes.”¹³² Correspondingly, 11 papers in our analysis set used the Fatality Analysis Reporting System (FARS) as a source of outcome data, eight used the Uniform Crime Reports (UCR) as source of outcome data, and four used other sources of outcome data.

We then described the key findings of each paper included in our analysis as fitting into one of four categories: decrease (meaning the paper found the cannabis law appeared to decrease the outcome), increase (meaning the paper found the cannabis law appeared to increase the outcome), null results (the paper found the cannabis law did not have an effect on the outcome in either direction), and mixed (the paper found a combination of positive and negative effects from the law). Figure 7 below summarizes the key findings of the papers included in this analysis.

¹²⁹ See Kaplan and Goh, *supra* note 110, at 5275, for a discussion identifying why they selected the year when their study concluded, but not the year when it began.

¹³⁰ Cook, Leung & Smith, *supra* note 115, at 3.

¹³¹ Richard A. Gurucza, et al., *Cannabis decriminalization: A study of recent policy change in five U.S. states*, 59 INT’L J. DRUG POL’Y 67 (2018).

¹³² David Makin, et al., *Marijuana Legalization and Crime Clearance Rates: Testing Proponent Assertions in Colorado and Washington State*, 22 POLICE Q. 31, 32 (2019). However, there is also a literature suggesting that cannabis legalization may make law enforcement investigations more difficult, as suspicion of cannabis possession is an easy pretext for law enforcement to conduct a search. See Stohr, et al., *An evolution rather than a revolution: Cannabis legalization implementation from the perspective of the police in Washington State*, 3 JUST. EVALUATION 267 (2020).

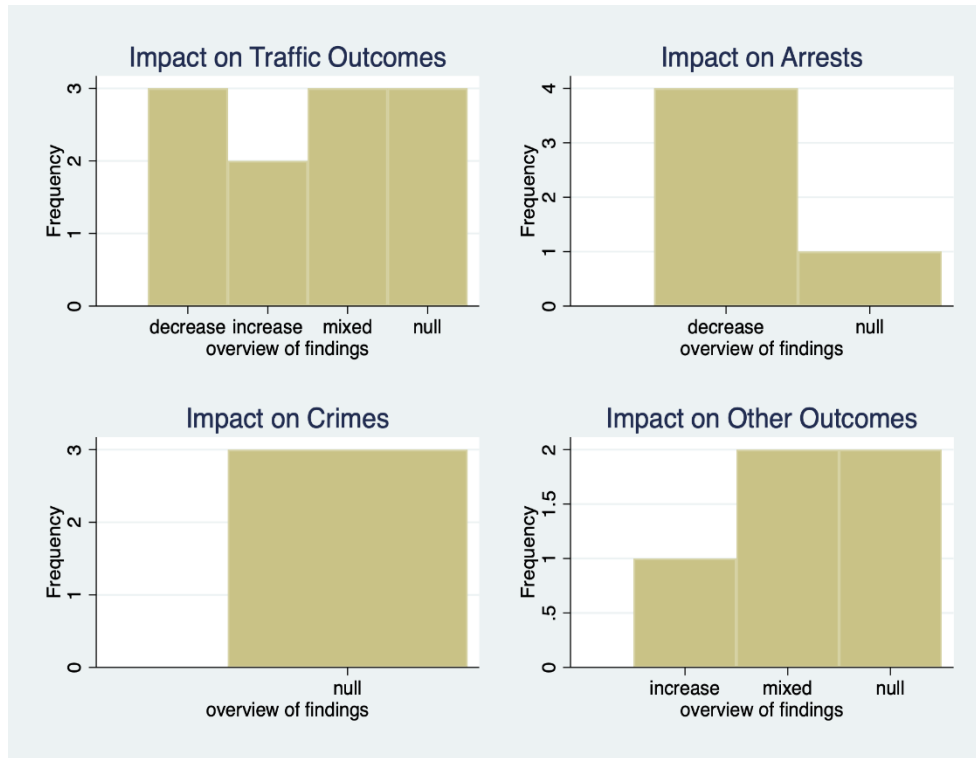
Figure 7: Overview of General Findings

Figure 7 suggests that—taken as a whole—the papers we studied present a consistent picture for some public safety outcomes, but not others. The papers we reviewed presented a decidedly more mixed picture of the effects of cannabis laws on traffic outcomes—which is perhaps surprising these studies all relied on Fatality Analysis Reporting System (FARS) data. As we will analyze further in the next section, this raises the question of whether this variation in paper results can be related to variation in the definition of cannabis variables used in these analyses.

In contrast, the public safety literature on the effects of cannabis laws on arrests and crimes was largely consistent—and appears even more consistent when the papers are considered in additional detail. Four out of five papers that we reviewed that studied the effects of cannabis laws on arrests focused on the impact of recreational cannabis laws and/or decriminalization on cannabis possession arrests—and all found that cannabis decriminalization and/or legalization decreased cannabis arrests (in line with expectations considering the policy change). The remaining paper (Maier, Mannes, and Koppenhofer (2017)) considered the effect of cannabis decriminalization and legalization on arrests for other drug possession—

testing a theory that increased access to cannabis could change use of other intoxicating substances—and found no effect.¹³³

All papers that we reviewed that studied the effects of cannabis laws on crime focused on the impact of legal measures found null results. However, it should be noted that these findings may be nuanced. In particular, although Lu, Willits, et al. (2021) found no long term effects on crime, they also found short-term increases in crime (which later subsided) and “a decline in [b]urglary in Washington.”¹³⁴ Although the authors caution that their results should not be over interpreted based on the short amount of time that had passed since legalization, these findings raise the question of whether some aspect of Washington’s recreational cannabis law or its implementation may have had a differential impact on burglary.

Five of the papers that we reviewed looked at the effect of cannabis laws on other public safety-related outcomes, often in addition to studying the effects of cannabis laws on traffic, arrest, or crime outcomes. As these papers looked at a range of public safety outcomes, it is to be expected that they did not find consistent effects. Makin, Willits, et al. looked at the impact of recreational cannabis laws on crime clearance rates, generally finding “marked improvements in clearance rates.”¹³⁵ Matthay, Kiang, et al. used a measure of cannabis laws that considered both the presence of medical cannabis laws, recreational cannabis laws, and both types of outlets to evaluate the impact of cannabis laws on insurance claims for self-harm and assault, finding an impact only for young males.

Finally, we considered whether the years of data included in the studies appeared to be related to their key findings, however, no pattern emerged when we separated the papers based on whether they used data from different eras of cannabis policymaking (i.e., before the Ogden memo, or after the Cole II memo).

E. *Patterns in Operationalization and Evaluation in Traffic Outcomes Papers*

Given the mixed literature we reviewed on the impact of cannabis laws on traffic related outcomes, we then more closely considered how cannabis laws were defined in these papers. Our goal was to explore potential patterns between the operationalization of cannabis laws used in the papers and the outcomes they observe. However, distinguishing between the broad categories of laws considered did little to create a more coherent picture. Of the six papers that included variables accounting for medical cannabis laws, three mostly found a decrease in traffic outcomes, two mostly found mixed results, and one mostly found null results. Of the eight papers that included variables accounting for recreational cannabis laws, one mostly found a decrease in traffic outcomes, two mostly found an increase in traffic

¹³³ Shana L. Maier, et al., *The Implications of Marijuana Decriminalization and Legalization on Crime in the United States*, 44 CONTEMP. DRUG PROBS 125, 139 (2017).

¹³⁴ Ruibin Lu, et al., *The Cannabis Effect on Crime: Time-Series Analysis of Crime in Colorado and Washington State*, 38 JUST. Q. 565, 579 (2021).

¹³⁵ Makin, et al., *supra* note 132 at 47.

outcomes, two mostly found mixed results, and three mostly found null results. The one paper that considered the impact of specific provisions on traffic outcomes—Seveigny (2018)—found significant results “only in jurisdictions with state-licensed medical marijuana dispensaries.”¹³⁶

We then considered whether the papers we reviewed with different traffic-related findings might be considering different years of data. Table 1 below describes the average start year and stop year of the data analyzed in the papers we reviewed that evaluated the impact of cannabis laws on traffic-related findings, broken out by the findings of each paper. As can be seen, papers that found that cannabis laws decreased traffic-related harms on average started and stopped earlier than other traffic-related papers we reviewed. In contrast, papers that found cannabis laws increased traffic-related harms started later than papers with mixed or null results, although these groups all had similar stop years. In particular, it should be noted that neither of the papers that found that cannabis legalization increased traffic-related harms included data before the release of the Ogden memo.

Table 1: Average Time Periods in Traffic-Related Cannabis Law Evaluations, by Finding

<i>Traffic-Related Findings</i>	<i>Average Start Year</i>	<i>Average Stop Year</i>
Decrease	1986	2014
Increase	2008	2016
Mixed	2002	2016
Null	2000	2016

III. DISCUSSION AND RECOMMENDATIONS

A. Discussion

Our analysis does not tell a clean story about the relationship between how cannabis laws have been measured in the public safety literature and the observed effects of these measures on public safety. The majority of the papers we reviewed considered cannabis laws as a set of binary variables capturing medical, recreational, and/or decriminalization laws. While the few papers that considered more complex ways of measuring cannabis law did sometimes find that certain aspects of policy were associated with differential outcomes,¹³⁷ the use of these measures was not widespread enough to draw strong conclusions about whether they impacted analytic results. Furthermore, while the literature we reviewed covered multiple eras of cannabis law (such as pre-Ogden Memo and post-Cole Memo), we found only scant suggestion that the cannabis law eras included in analyses impacted the estimated effect of the cannabis laws on public safety outcomes. There was some suggestion that analyses which found cannabis laws decreased traffic-related harms might focus

¹³⁶ Seveigny, *supra* note 116, at 57.

¹³⁷ See *e.g.*, *id.*

more on early years of data than analyses that found cannabis laws increased traffic-related harms. However, further work is needed to determine whether this difference is due to the years under consideration or if there could potentially be an alternative explanation underlying this observed difference.

We would also like to acknowledge the limitations of this research. Our goal in reviewing these papers was to provide a narrative overview of how they are (or are not) contending with the substantial variation in cannabis law over time and place, rather than reanalyzing the underlying data to determine whether more nuanced cannabis law variables enhance our current understanding of the impact of cannabis legalization on public safety outcomes. While we hope our analysis might facilitate future research efforts in that direction, we do not contend that those goals are accomplished by the narrative review presented in this article. Additionally, the narrow set of public safety concerns that we used to structure this analysis are by no means the only important consequences of cannabis legalization. Even if there are public safety harms or benefits associated with cannabis legalization, these harms or benefits may be outweighed by countervailing public health or equity considerations. Consequently, this research should be seen as an investigation along one dimension of an immensely complex social problem.

B. *Recommendations for Evaluating Cannabis Laws*

The variation in cannabis law, over both time and place, presents an opportunity and a challenge for researchers interested in the effects of these laws on public safety. On one hand, variety in the types of laws passed can allow researchers additional leverage to explore what characteristics of these laws appear to change behavior and outcomes in order to provide actionable information for lawmakers. For example, if improved public safety outcomes are only observed in states that pass laws with a certain set of characteristics, then lawmakers should be encouraged to adopt laws with those characteristics. On the other hand, identifying variation in laws—and reducing this variation into a set of variables that can be incorporated into an analysis—can be a time consuming, expensive process that often requires specialized legal expertise.¹³⁸ In this section, we outline important considerations for researchers considering taking on the challenges associated with evaluating cannabis laws.

First, all researchers—regardless of the level of nuance they incorporate into their measurement of cannabis law—should be sure to provide sufficient information that readers can understand and replicate the cannabis law variables they have created. Replicability is an important goal in science, as it can help verify existing studies, identify potential new pathways for research, and promote careful

¹³⁸ Alia Hoss, Corey S. Davis, & Scott Burris, *Yes, You Need a Lawyer: Integrating Legal Epidemiology Into Health Research*, 135 PUB. HEALTH REP 856 (2020).

research.¹³⁹ To ensure that studies are described in enough detail that they can be replicated, researchers evaluating cannabis laws should provide a clear definition of what counts as a cannabis law for purposes of their study,¹⁴⁰ and state whether they are using enacted dates, effective dates, or some other date to define the cannabis law variable. In addition, tables or appendices providing “states and dates”—a clear list of states that enacted cannabis laws during the time period of the study, and the dates used for purposes of creating the cannabis law variables—are an incredible resource to those crafting future cannabis law evaluations. While many papers we reviewed met this standard, not all did.

Second, researchers should justify why the cannabis law variables they have created are appropriate to answer their research question. To motivate their study, researchers frequently explain why theory or prior literature suggests that cannabis laws may have an impact on the outcome they are studying.¹⁴¹ For example, they might hypothesize that legalizing cannabis will increase consumption by signaling that cannabis use is socially acceptable, or by making it easier and less expensive to obtain cannabis.¹⁴² While both of these arguments postulate that legalizing cannabis would increase consumption (and, consequently, public health and safety consequences associated with consumption), they likely require different construction of cannabis law variables. On one hand, a researcher arguing that cannabis legalization increases consumption by making cannabis use appear more socially acceptable may want to consider creating their cannabis law variables using each law’s enactment date (since the removal of the legal prohibition could signal social acceptability). On the other hand, a researcher arguing that cannabis legalization increases consumption by making it easier and less expensive to obtain cannabis may be more interested in creating their cannabis law variables using the date cannabis became available through legal means in the state (which could be substantially later, particularly if the state law limited individuals to obtaining cannabis through state-licensed cannabis outlets rather than growing their own cannabis at home).

Third, researchers going forward might consider incorporating more nuanced descriptions of cannabis law in their analyses, particularly for areas where the literature has not produced consistent estimates of the effects of cannabis law (such as the literature on the impact of cannabis laws on traffic outcomes). As we have discussed, state cannabis laws have varied significantly over time and place, and the

¹³⁹ Jeremy Freese & David Peterson, *Replication in Social Science*, 43 ANN. REV. OF SOCIO 147 (2017).

¹⁴⁰ For example, Seveigny (2018) defined state medical cannabis laws through whether they provided legal protections to medical cannabis patients. Seveigny, *supra* note 116, at 58.

¹⁴¹ See Charles Tremper, Sue Thomas, & Alexander C. Wagenaar, *Measuring Law for Evaluation Research*, 34 EVALUATION REV. (2010) for a discussion of how legal measures can be developed to support evaluation.

¹⁴² For a comprehensive discussion of potential mechanisms through which cannabis legalization may change behavior, see Wayne Hall & Michael Lynskey, *Evaluating the public health impacts of legalizing recreational cannabis use in the United States*, 111 ADDICTION, 1764 (2016).

theoretical literature and existing research suggests that this variation could have differential impacts on cannabis behaviors and consequently cannabis-related outcomes. Conducting evaluations using more fine-grained measures of cannabis law might lead to a better understanding of the effects of current laws, as it may identify characteristics of laws that lead to better (or worse) outcomes. Simultaneously, use of these fine-grained policy measures would ensure more policy-relevant cannabis research, as it could help lawmakers craft laws with characteristics that are most likely to improve (or not harm) public safety outcomes.

To do this, researchers should identify characteristics of cannabis laws that they hypothesize could drive changes in consumption and public safety outcomes, and then construct cannabis variables that account for these characteristics.¹⁴³ Notably, this means that researchers with different theories of why cannabis law may hinge behaviors might include different cannabis law variables in their analyses. Returning to our previous example, the researcher who argues that cannabis legalization increases consumption by making cannabis use appear more socially acceptable might be interested in measures that signal increased public acceptance of cannabis (such as the passage of a cannabis law through initiative processes rather than legislative processes). In contrast, the researcher who argues that cannabis legalization increases consumption by making it easier and less expensive to obtain cannabis might focus on measures that would restrict the availability or affect the price of cannabis (such as limits on the number of cannabis outlets allowed or cannabis-related taxes). Taken together, these research projects would provide a more complete picture not just of whether cannabis laws impact cannabis consumption and related outcomes, but how and why these impacts occur.

Fourth, researchers studying the impact of cannabis laws on public safety outcomes may also want to consider developing or adopting cannabis policy scales¹⁴⁴ or typologies¹⁴⁵ to provide more nuanced measures of the cannabis laws in place in states over time. The use of policy scales and typologies is becoming increasingly common in the public health literature;¹⁴⁶ however, as these measures were developed to capture the aspects of the laws that would be most relevant to their public health impacts, it is not immediately clear how easily they could be transitioned to use in the context of public safety evaluations. Researchers should therefore consider whether the aspects of cannabis laws captured by existing scales appropriately represent the aspects of cannabis law that they believe will impact

¹⁴³ For additional resources on how legal variables can be constructed to support a variety of research goals, see Temple University Center for Public Health Law Research, *Theory & Methods*, <https://phlr.org/theory-methods> [<https://perma.cc/QFU7-G4FE>] (last visited Aug. 2023).

¹⁴⁴ Jason G. Blanchette, et al., *Rating the comparative efficacy of state-level cannabis policies on recreational cannabis markets in the United States*, 106 INT'L. J. OF DRUG POL'Y 103744 (2022).

¹⁴⁵ Grant Neely & Lilliard E. Richardson, *Marijuana Policy Bundles in the American States Over Time and Their Impact on the Use of Marijuana and Other Drugs*, 46 EVALUATION REV. 165 (2022).

¹⁴⁶ Susan A. Chapman, et al., *Capturing Heterogeneity in Medical Marijuana Policies: A Taxonomy of Regulatory Regimes Across the United States*, 51 SUBSTANCE USE & MISUSE 9 (2016).

public safety outcomes and, to the extent they are not, develop separate measures for use in public safety evaluations.

Finally, in light of the substantial variation in cannabis law over time, public safety researchers may be interested in using direct measures of the cannabis market (such as the number of registered medical cannabis patients, legal cannabis outlet density, or cannabis sales) instead of relying on cannabis law variables. While there is an important literature on the impact of cannabis markets on public safety, this is a complement to—not a substitute for—a robust literature that exploits variation in the impacts of cannabis laws. Direct measures of the cannabis market are not always available, and relying on measures of the licit market (such as the number of licensed outlets) can obscure the continued existence and potential impact of the illicit market.¹⁴⁷ In addition, laws are important mechanisms through which policymakers shape licit cannabis markets, so understanding their impact on public safety outcomes is key for developing safety-promoting policies in the future.

C. Recommendations for Lawmakers

In light of the above discussion, policymakers should carefully consider the characteristics of the cannabis laws they are considering adopting to ensure they are enacting laws likely to accomplish their underlying social goals. However, as our analysis of the current literature demonstrates, the available research does not always provide clear answers about the impact of particular aspects of cannabis laws on public safety outcomes. In particular, while there appears to be consistent evidence that cannabis legalization will reduce arrests for cannabis possession, the impact of cannabis legalization on traffic-related harms is much less clear-cut. Accordingly, lawmakers who are interested in enacting cannabis laws may also want to prepare for policy experimentation by creating mechanisms for reviewing and revisiting those laws. One potential mechanism for accomplishing this is through the use of sunset provisions, which “provide[] for the automatic expiration of a law after a fixed amount of time unless the legislature makes an affirmative act of reauthorization.”¹⁴⁸ If implementation of the cannabis law is going well, the legislature can reauthorize it periodically or remove the sunset provision to make it permanent; if implementation does not go well, they can allow it to expire. There has already been some experimentation with sunset provisions in the context of cannabis law: Vermont S.54, the law which created their legal cannabis market,

¹⁴⁷ Compare Eric R. Pedersen, et al., *Examining Associations Between Licensed and Unlicensed Outlet Density and Cannabis Outcomes From Preopening to Postopening of Recreational Cannabis Outlets*, 30 *Am. J. on Addictions* 122 (2021) with Michael Williams, et al., *Accuracy Differences in Cannabis Retailer Information Ascertained from Webservices and Government-Maintained State Registries Across US States Legalizing the Sale of Cannabis in 2019*, CANNABIS (2023).

¹⁴⁸ Melissa J. Mitchell, *Cleaning Out the Closet: Using Sunset Provisions to Clean Up Cluttered Criminal Codes*, 54 *EMORY L.J.* 1671, 1696 (2005).

included a provision that automatically repealed the sections of their statute related to the Cannabis Control Board.¹⁴⁹

Additionally, lawmakers should enable robust monitoring of cannabis law implementation and data collection on key public safety outcomes. While state-level cannabis laws themselves can typically be easily obtained through state legislature websites and commonly-used commercial databases, details about how these laws have been put into effect—including, for example, where and when cannabis business licenses were granted¹⁵⁰—may be difficult or impossible to obtain unless this information is released by the relevant policy actors. At the same time, publication of data encourages use of that data in research—and accordingly facilitates the development of policy-informing research using those data.¹⁵¹ Additionally, lawmakers should ensure that data are available on relevant public safety outcomes and that this data is constructed in such a way that data can be validly compared across jurisdictions and over time, a key requirement for many types of analyses. While this might appear to be a given, recent changes in crime data collection methods may undermine researcher’s ability to use several workhorse datasets.¹⁵²

¹⁴⁹ S.54 § 6e (Vt. 2020). This section was later repealed by H.R.270 (Vt. 2023).

¹⁵⁰ This information has been published by some but not all states. See, for example, Colorado Marijuana Enforcement Division, *MED Licensed Facilities*, <https://sbg.colorado.gov/med/licensed-facilities> (last visited Aug. 2023) for a links to lists of licensed cannabis businesses by type in Colorado [<https://perma.cc/56JH-SRNW>].

¹⁵¹ In particular, Washington state had a publicly available database of cannabis retail transactions, which enabled a substantial amount of policy-relevant research. See, e.g., Jonathan P. Caulkins, et al., *Big data on a big new market: Insights from Washington State’s legal cannabis market*, 57 INT’L. J. DRUG POL. (2018). Nick Jikomes and Michael Zoorob, *The Cannabinoid Content of Legal Cannabis in Washington State Varies Systematically Across Testing Facilities and Popular Consumer Products*, 8 NATURE SCI. REP 4519 (2018), and Rosanna Smart, et al., *Variation in cannabis potency and prices in a newly legal market: evidence from 30 million cannabis sales in Washington State*, 112 ADDICTION 2167 (2017).

¹⁵² Weihua Li, *What Can FBI Data Say About Crime in 2021? It’s Too Unreliable to Tell*, The Marshall Project (2022), available at <https://www.themarshallproject.org/2022/06/14/what-did-fbi-data-say-about-crime-in-2021-it-s-too-unreliable-to-tell> [<https://perma.cc/NBE8-LPRX>].

Appendix A
Papers Included

<i>Authors</i>	<i>Title</i>	<i>Journal</i>	<i>Year</i>	<i>CL Types</i>	<i>Data</i>	<i>Data Years</i>
Anderson, Hansen, and Rees	Medical Marijuana Laws, Traffic Fatalities, and Alcohol Consumption	Journal of Law and Economics	2013	MCL	FARS	1990–2010
Aydelotte, Brown, et al.	Crash fatality rates after recreational marijuana legalization in Washington and Colorado	American Journal of Public Health	2017	RCL	FARS	2009–2015
Hamzeie, Thompson, et al.	State-Level Comparison of Traffic Fatality Data in Consideration of Marijuana Laws	Transportation Research Record	2017	RCL Decrim	FARS	2010–2014
Santaella-Tenorio, Mauro, et al.	US traffic fatalities, 1985-2014, and their relationship to medical marijuana laws	American Journal of Public Health	2017	MCL	FARS	1985–2014
Maier, Mannes, and Koppenhofer	The implications of marijuana decriminalization and legalization on crime in the United States.	Contemporary Drug Problems: An Interdisciplinary Quarterly	2017	MCL RCL Decrim	UCR	2010–2014
Sevigny	The effects of medical marijuana laws on cannabis-involved driving.	Accident Analysis and Prevention	2018	MCL RCL Decrim	FARS	1993–2014

Gurucza, Vuolo, et al.	Cannabis decriminalization: a study of recent policy change in five U.S. states	International Journal of Drug Policy	2018	Decrim	UCR Other	2007–2015
Makin, Willits, et al.	Marijuana Legalization and Crime Clearance Rates: Testing Proponent Assertions in Colorado and Washington State.	Police Quarterly	2019	RCL	UCR	2010–2015
Plunk, Peglow et al.	Youth and Adult Arrests for Cannabis Possession After Decriminalization and Legalization of Cannabis.	JAMA Pediatrics	2019	RCL Decrim	UCR	2000–2016
Pressley, Arora, and Sarmah	Marijuana use in U.S. teen drivers: a comparison of a road-side survey of reported use and fluid tests for tetrahydrocannabinol (THC).	Injury epidemiology	2019	MCL	Other	2013–2014
Chu and Townsend	Joint culpability: The effects of medical marijuana laws on crime.	Journal of Economic Behavior & Organization	2019	MCL RCL Decrim	UCR	1988–2013

Santaella-Tenorio, Wheeler-Martin, et al.	Association of recreational cannabis laws in Colorado and Washington State with changes in traffic fatalities, 2005–2017.	JAMA Internal Medicine	2020	RCL	FARS	2005–2017
Hansen, Miller, and Weber	Early Evidence on Recreational Marijuana Legalization and Traffic Fatalities	Economic Inquiry	2020	RCL	FARS	2000–2016
Cook, Leung, and Smith	Marijuana decriminalization, medical marijuana laws, and fatal traffic crashes in U.S. cities, 2010–2017	American Journal of Public Health	2020	MCL Decrim	FARS	2010–2017
Calvert and Erickson	An examination of relationships between cannabis legalization and fatal motor vehicle and pedestrian–involved crashes.	Traffic injury prevention	2020	MCL RCL	FARS	1991–2018
Lu, Willits, et al.	The Cannabis Effect on Crime: Time-Series Analysis of Crime in Colorado and Washington State.	JQ: Justice Quarterly	2021	RCL	UCR	1999–2016

Windle, Eisenberg, et. al	Association between legalization of recreational cannabis and fatal motor vehicle collisions in the United States: an ecologic study.	CMAJ open	2021	RCL	FARS	2007–2018
Dewey, Kindle, et al.	State Marijuana Laws and Traffic Fatalities	The Review of Regional Studies	2021	MCL RCL	FARS	1985–2019
Sheehan, Grucza, and Plunk	Association of Racial Disparity of Cannabis Possession Arrests Among Adults and Youths With Statewide Cannabis Decriminalization and Legalization.	JAMA Health Forum	2021	RCL Decrim	UCR	2000–2019
Matthay, Kiang, et al.	Evaluation of State Cannabis Laws and Rates of Self-harm and Assault.	JAMA Network Open	2021	MCL RCL	Other	2003–2017
Gunadi and Shi	Association of Recreational Cannabis Legalization With Cannabis Possession Arrest Rates in the US.	JAMA Network Open	2022	RCL	UCR	2010–2019
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