

ASSESSMENT OF THE POTENTIAL IMPACT OF REGULATED MARIJUANA IN NEW YORK STATE

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Charge

In his January 2018 budget address, Governor Andrew M. Cuomo called for an assessment of the possible impact of regulating marijuana in New York State (NYS). The Governor directed NYS agencies to evaluate the health, public safety, and economic impact of legalizing marijuana. The experience of legalized marijuana in surrounding states was identified as an important issue to consider in the impact assessment.

Review Process

Pursuant to the Governor's charge, a thorough review was conducted of the health, criminal justice and public safety, economic, and educational impacts of a regulated marijuana program in NYS. The assessment included an examination of the implications of marijuana legalization that has recently occurred in surrounding jurisdictions. This is particularly important because the status quo in NYS is changing as the State shares borders with some jurisdictions that have legalized marijuana and some that are likely to legalize soon.

This impact assessment involved a public health approach to examining the benefits and risks associated with legalizing marijuana in NYS as compared to maintaining the status quo. In developing the impact assessment, an extensive analysis of peer-reviewed literature was conducted, and information was obtained from jurisdictions that have legalized marijuana. In addition, experts in State agencies were consulted, including the Department of Health (DOH), the Office of Mental Health, the Office of Alcoholism and Substance Abuse Services, the NYS Police, the Office of Children and Family Services, the Department of

Taxation and Finance, and the Department of Transportation.

Notably, some issues associated with regulating marijuana have been studied more thoroughly than others. In addition, relevant stakeholders with differing viewpoints have weighed in on the potential impact of legalizing marijuana. To ensure a comprehensive assessment, data from a variety of sources were acquired. Given the variety of sources utilized and the breadth of information contained in this report, some areas of potential impact contain discordant findings or viewpoints.

Introduction

Marijuana can be consumed by inhalation (smoking and vaporizing^I), oral consumption and topicals. It contains a mix of THC^{II}, cannabidiol (CBD)^{III}, terpenes,^{IV} and other compounds.

Marijuana is easily accessible in the unregulated market. A 2017 Marist Poll showed that 52 percent of Americans 18 years of age or older have tried marijuana at some point in their lives, and 44 percent of these individuals currently use it.¹ Estimates from the National Survey on Drug Use and Health (NSDUH) indicate that one in ten New Yorkers used marijuana in the last month.² The status quo (i.e., criminalization of marijuana) has not curbed marijuana use and has, in fact, led to unintended consequences, such as the disproportionate criminalization and incarceration of certain racial and ethnic groups that has a negative impact on families and communities.

From the late 1800s until the 1930s, marijuana was generally considered a benign, medically efficacious substance that was sold in pharmacies and doctors' offices throughout the United States to treat various ailments. During the "reefer madness" era

^I **Vaporizing** is the process of heating dried marijuana to a temperature just below its combustion point of 392°F. Vaporizers, devices used to use marijuana this way, consist of a heating source and a delivery system.

^{II} **Tetrahydrocannabinol (THC)** is the primary psychoactive component in marijuana which binds to the cannabinoid receptors primarily in the brain.

^{III} **Cannabidiol (CBD)** is a marijuana compound that has medical benefits but is not psychoactive. CBD is one of approximately 113 cannabinoids identified in cannabis.

^{IV} **Terpenes** are a diverse class of hydrocarbons that are responsible for the aroma of the marijuana plant.

of the 1930s, there was a concerted effort to convince the country that marijuana posed such a danger to society, only prohibition could save it, and the risks continued to be exaggerated for many years through propaganda.³

In 1999 the Institute of Medicine (IOM) found a base of evidence to support the benefits of marijuana for medical purposes.⁴ There is a growing body of evidence that marijuana has health benefits. Peer-reviewed literature, news reports, and anecdotal evidence demonstrate that marijuana is beneficial for the treatment of pain, epilepsy, nausea, and other health conditions. Twenty-nine states and Washington, DC, have established medical marijuana programs that benefit patients with numerous conditions. Success with medical programs across the country has led some jurisdictions to legalize marijuana for regulated adult use⁵ (eight states and Washington, DC). Low THC/high CBD^v products are approved in 17 additional states (See Appendix A Figure 1).⁶

In addition, studies have found notable associations of reductions in opioid prescribing and opioid deaths with the availability of marijuana products. States with medical marijuana programs have been found to have lower rates of opioid overdose deaths than other states.

In 2014, Governor Cuomo signed the Compassionate Care Act into law, establishing New York State's Medical Marijuana Program. Since the program was established, continued improvements have been made to better serve patients. To improve patient access, nurse practitioners and physician assistants were approved to certify patients for medical marijuana, and the number of organizations approved to manufacture and dispense medical marijuana was increased. In addition, the list of qualifying conditions was expanded to include chronic pain and post-traumatic stress disorder. Most recently, in response to the unprecedented opioid epidemic, it

was announced that opioid use will be added as a qualifying condition to ensure that providers have as many options as possible to treat patients. Other program enhancements include extending the variety of medical marijuana products, improving the dispensing facility experience, and streamlining program requirements. The State's Medical Marijuana Program is a national model, with almost 1,700 registered providers and 59,653 certified patients.

In addition to health impacts, the prohibition of marijuana has had significant impacts on criminal justice. The Marijuana Reform Act of 1977 decriminalized private possession of a small amount of marijuana, punishable by a maximum fine of \$100. However, possession of marijuana in public view remains a misdemeanor. Over the past 20 years, there have been more than 800,000 arrests for marijuana possession, and the increasing emphasis on minor marijuana arrests has had a disproportionate impact on communities of color.⁷ The over-prosecution of marijuana has had significant negative economic, health, and safety impacts that have disproportionately affected low-income communities of color. In 2012, the Governor introduced legislation to ensure that possession of a small amount of marijuana, whether public or private, is treated as a violation and not as a misdemeanor. The legislature failed to adopt the proposal. Because of the over-prosecution of marijuana, a regulated program in NYS should include provisions to address the collateral consequences of prior criminal convictions for marijuana possession or use, such as barriers to housing and education. As the Governor has stated, the impact of legalization in surrounding states has accelerated the need for NYS to address legalization. It has become less a question of whether to legalize but how to do so responsibly.

A regulated marijuana program would have health social justice and economic benefits. However, risks

^v **Low THC/high CBD products** do not have psychoactive components and are used for medicinal purposes through oral ingestion or topical application. These

products can be legal in states that do not have a medical marijuana program.

associated with marijuana have been identified, although research for some of those risks is divided. For example, research has demonstrated an association between maternal marijuana smoking and lower birth weight of newborns. Marijuana use may be harmful to the lungs if a combustible form is smoked. For individuals who are susceptible to psychosis, regular use lowers age of onset of psychosis.⁸ In addition, there are valid concerns about traffic safety. Risks can be monitored and reduced in a regulated marijuana environment with the establishment of regulations that enhance State control. Regulating marijuana enables public health officials to minimize the potential risks of marijuana use through outreach, education, quantity limits at point of sale, quality control, and consumer protection.

The positive effects of regulating an adult (21 and over) marijuana market in NYS outweigh the potential negative impacts. Harm reduction principles can and should be incorporated into a regulated marijuana program to help ensure consumer and industry safety. Legalizing marijuana could remove research restrictions in NYS, which will enable the State to add to the knowledge of both the benefits and risks. In addition, NYS would be one of the largest regulated marijuana markets. As such, there is potential for substantial tax revenue in NYS, which can be used to help support program initiatives in areas such as public health, education, transportation, research, law enforcement and workforce development. Tax revenues can also support health care and employment. Finally, legalization of marijuana will address an important social justice issue by reducing disproportionate criminalization and incarceration of certain racial and ethnic minority communities.

Findings

I. Health

Regulating marijuana reduces risks and improves quality control and consumer protection.

The organization *Doctors for Cannabis Regulation* states that regulation benefits public health by enabling government oversight of the production, testing, labeling, distribution, and sale of marijuana.⁹ Potency can vary widely based on the strain of marijuana, the way the plant is grown, the part of the plant that is used, how it is stored, and how it is consumed.¹⁰ Consumers purchasing marijuana on the unregulated market are at a severe disadvantage for understanding the nature (e.g., potency and safety) of the product they are acquiring. In an unregulated market where there is no standardization or quality control, there are many opportunities for unsafe contaminants to be introduced, such as fungi spores, mold, bacteria, heavy metals, pesticides, and growth enhancers. As such, regulated marijuana introduces an opportunity to reduce harm for consumers through the requirement of laboratory testing and product labeling.¹¹ Similar protections are in place for the alcohol and tobacco industries. In a regulated environment, individuals know what they are consuming and can choose a product accordingly. Trained employees can provide guidance and education at point of sale.

- ***Subject matter experts noted that a regulated environment will support consumer choice of content, because education about THC and CBD levels can be made available. Consumers can be given information about the experience they can expect based on the product they purchase and the method of ingestion. Comparisons were made to New York's Medical Marijuana Program, in which pharmacists and patient counseling are available in dispensaries. People are advised to 'start low and go slow' and find the right fit for them.***

Research in Colorado found after medical marijuana legalization, there was a significant increase in the number of children under age 12 admitted to emergency rooms due to unintentional marijuana ingestion (over half the cases involved medical marijuana “edibles”).¹²

A regulated marijuana program should create guidelines to ensure packaging is not attractive to children. Packaging should be child proof and opaque and contain a visible warning label to avoid accidental ingestion and deter minors from using the products. Testing and labeling products will ensure quality and protect public health. A harm reduction approach will ensure consumers are informed about their choices and understand the chemical make-up and potency of the products they purchase.

Marijuana may reduce opioid deaths and opioid prescribing.

Research indicates that regulating marijuana can reduce opioid use (legal and illegal). Medical marijuana has added another option for pain relief which may reduce initial prescribing of opioids and assist individuals who currently use opioids to reduce or stop use. Legalization may ease access to marijuana for pain management. The opioid epidemic in NYS is an unprecedented crisis.¹³ Diagnoses of opioid use disorder are on the rise.¹⁴ Besides the dramatic increase in the number of deaths in the past few years, this epidemic has devastated the lives of those with opioid use disorder, along with their families and friends. Those with opioid use disorder are at higher risk for HIV, Hepatitis C, and chronic diseases.¹⁵

In NYS, overdose deaths involving opioids increased by about 180 percent from 2010 (over 1,000 deaths) to 2016 (over 3,000 deaths).¹⁶ Opioid overdose is now commonplace throughout NYS. Marijuana is an effective treatment for pain, greatly reduces the chance of dependence, and eliminates the risk of fatal overdose compared to most opioid-based medications.¹⁷ Studies of some states with medical marijuana programs and/or regulated adult-use have found notable associations of

reductions in opioid deaths and opioid prescribing with the availability of marijuana products. States with medical marijuana programs have been found to have lower rates of opioid overdose deaths than other states,¹⁸ perhaps lower by as much as 25 percent.¹⁹ Studies on opioid prescribing in some states with medical marijuana laws have noted a 5.88 percent lower rate of opioid prescribing, and the implementation of adult-use marijuana laws (which all occurred in states with existing medical marijuana laws) was associated with a 6.38 percent lower rate of opioid prescribing.²⁰ Following legalization of adult-use marijuana in Colorado, the State saw a short-term reversal of the upward trend in opioid-related deaths.²¹

A regulated marijuana program should promote awareness of marijuana as an effective pain treatment and an alternative to opioids. A regulated marijuana program should coordinate with the State’s Medical Marijuana Program and provide education on the assistance that is available through the Medical Marijuana Program.

Marijuana has intrinsic health benefits and risks.

Evidence supports the efficacy of marijuana’s therapeutic benefits. Growing research has demonstrated that marijuana is beneficial for the treatment of pain, epilepsy, nausea, and other health conditions. The medicinal benefits of marijuana have been acknowledged.²² The negative health consequences of marijuana have been found to be lower than those associated with alcohol, tobacco and illicit drugs including heroin and cocaine.^{23,24}

There is an association between marijuana use and impairment in the cognitive domains of learning, memory, and attention (due to acute marijuana use).^{25, 26}

Amotivational syndrome is anecdotally reported to be associated with chronic marijuana use. This is not supported in the literature. One study found that while cannabis was associated with a transient amotivational state, dependence was not associated with amotivation.²⁷ Another study, using

a survey to compare daily users to never-users found no difference in motivation as measured by an Apathy Scale.²⁸

Marijuana may be harmful to the lungs if a combustible form is smoked. However, alternatives can be used (e.g., vaping, edibles). Regulating marijuana will provide an opportunity to furnish information regarding the various methods of consumption.

Most women who use marijuana stop or reduce their use during pregnancy.²⁹ There is research that demonstrates an association between maternal marijuana smoking and lower birth weight of the newborn. Data have not identified any long-term or long-lasting meaningful differences between children exposed to marijuana in utero and those not exposed.³⁰ There are insufficient data to evaluate the effects of marijuana use on infants during lactation and breastfeeding, and in the absence of such data, marijuana use is discouraged. The American College of Obstetrics and Gynecology (ACOG) recommends that women who are pregnant should be discouraged from using marijuana due to concerns regarding impaired neuro-development as well as maternal and fetal exposure to the adverse effects of smoking. The ACOG recommends seeking alternative therapies for which there are better pregnancy-specific safety data.³¹

A regulated marijuana program should furnish education about the health benefits and risks of marijuana and provide guidelines to reduce potential harms of marijuana use.

Marijuana can have effects on mental health.

There is little evidence that marijuana use is significantly or causally associated with more common mental illnesses (such as mild-to-moderate depression or anxiety) or other adverse outcomes (such as suicide) in the general population. Regular marijuana use in youth is associated with lower academic achievement,³² but causation is unclear (e.g., cognitive vs. motivation vs. other factors).³³

There is strong evidence that individuals with serious mental illnesses (SMI) in general, including psychotic disorders, bipolar disorders, and serious depression, use marijuana at high rates, and those who continue using marijuana have worse outcomes and functioning.³⁴

Adolescents who use marijuana regularly have an increased risk of developing psychosis.³⁵ Additionally, for individuals who are susceptible to psychosis, regular use of marijuana lowers the age of onset of psychotic disorders.³⁶ People with psychotic disorders who use marijuana regularly have worse symptoms, functioning, and health outcomes, and stopping marijuana use improves mental health outcomes.^{37,38}

In individuals diagnosed with bipolar disorder, there is evidence of an association between regular marijuana use and increased symptoms of mania and hypomania.^{39,40}

It is important to note that there is some evidence that CBD can reduce the effect of THC on psychosis, and using marijuana with lower levels of THC may be less likely to be associated with the development of psychosis.⁴¹ In addition, research has shown that genetics and other environmental factors also have significant effects on the course of SMI.⁴²

➤ *Subject matter experts noted that there are many possible confounding factors when examining the relationship between marijuana use and various health outcomes, and we should, therefore, be careful about stating as fact that one thing causes another. Others noted there is substantial evidence of the effects of marijuana use on persons at risk for psychotic illnesses, and there is controversy about its effects on people with less serious mental illnesses such as milder depression and anxiety.*

Public health surveillance and education officials will need to conduct surveillance on youth marijuana use and any possible impacts on the onset and incidence of psychosis, as well as effects on academic achievement. Mental health professionals will need to monitor the effects of

marijuana legalization on the population with SMI, and resources will need to be directed to prevention, harm reduction and treatment efforts for individuals with SMI.

Changes in overall patterns of use are not likely to be significant.

It is likely that some people who have never used marijuana before due to fear of legal repercussions may try marijuana once legal sanctions are lifted.⁴³ Some states that have a regulated marijuana program have seen a slight increase in adult use, while other states have seen no increase at all.⁴⁴ This does not mean that those individuals will become regular or even semi-regular marijuana users.⁴⁵

It is important to note that reported increases in the number of people who use marijuana can be partially attributed to under-reporting prior to legalization, when there is reluctance to report illegal drug use due to fear of legal repercussions and stigma. Decreasing social stigma surrounding marijuana and no longer having to fear legal repercussions can lead to accurate reporting on use in surveys after legalization.⁴⁶

- *Subject matter experts noted that there is no conclusive evidence about whether legalizing marijuana increases use. It was pointed out that as with alcohol, use varies. Subject matter experts noted that brief increases in use in Colorado and Washington leveled out. They noted that such increases are, at least in part, the result of tourism. People in states without legal access are willing to travel to states where marijuana is legal. As more of the country legalizes, these increases will fade.*

A regulated marijuana program should monitor and document patterns of use to evaluate the impact of legalization on use.

The majority of credible evidence suggests legalization of marijuana has no or minimal impact on use by youth.

Criminalization in the U.S. has not curbed teen use. Marijuana is the most commonly used illicit

substance by adolescents.⁴⁷ Eighty to ninety percent of American eighteen-year-olds have consistently reported that marijuana is “very easy” or “fairly easy” to obtain since the 1970s.⁴⁸ Research regarding tobacco demonstrates that establishing a suitable minimum legal age can have a dramatic impact on youth access. Research has identified a variety of mechanisms by which youth obtain tobacco, one of which is social sources. Friends who are 18 years of age or over are a major source of tobacco for older adolescents.⁴⁹ Data provides a strong reason to believe that increasing the minimum legal age to 21 will contribute to reductions in youth tobacco use. Drawing parallels from tobacco research, regulating marijuana would enable the State to establish controls over marijuana use, including setting legal age limits, which will reduce youth access to marijuana. In addition, the creation of a regulated marijuana program would establish a legal distinction between underage and adult marijuana use.⁵⁰

- *Subject matter experts noted that marijuana will be more difficult for youth to obtain in a regulated marijuana environment. They stated it is easier for teens to get marijuana than alcohol because alcohol is regulated and marijuana is not. They asserted that the illicit economy operates now with no rules or regulations, youth know how to obtain marijuana, and the notion that regulation will foster greater demand is unfounded.*

Law enforcement raised a concern about a report from the Rocky Mountain High Intensity Drug Trafficking Area (RMHIDTA), which tracked the impact of marijuana legalization in the State of Colorado and found that youth past-month marijuana use increased 20 percent in the two-year average (2013-14) since Colorado legalized regulated marijuana compared to the two-year average prior to legalization.

However, other studies have shown little or no change in adolescent marijuana use following legalization. Data from multiple sources indicate that legalization in Colorado had no substantive impact on youth marijuana use.⁵¹ Marijuana use rates, both lifetime use and current use, among

high school students in Colorado did not change significantly following legalization. Similarly, past 30-day use among persons 12-17 years old in Colorado did not change significantly following legalization.⁵² A 2017 study of adolescent marijuana use before and after regulated marijuana implementation in Colorado found there was little change in adolescent marijuana use but a significant increase in perception of ease of access.⁵³ Moreover, post legalization rates in Colorado were not significantly different from usage rates nationally.⁵⁴

Meta-analysis of existing literature does not support the hypothesis that recent changes to marijuana laws have led to an increase in marijuana use prevalence in adolescents.⁵⁵ According to the 2016 U.S. Substance Abuse and Mental Health Services Administration National Survey on Drug Use and Health, rates of marijuana use among the nation's 12- to 17-year-olds dropped to their lowest level in more than two decades. According to a 2016 report from the State of Oregon, recent trends in youth use have been stable during the period following the enactment of adult-use regulations.⁵⁶ A Washington State evaluation report states that across grades 6, 8, 10, and 12, marijuana use indicators have been stable or fallen slightly since legalization. The Monitoring the Future Survey conducted by the National Institute on Drug Abuse (NIDA) found that lifetime and current marijuana use among 8th and 10th graders fell substantially between 1996 and 2016 and remained stable among 12th graders nationally.⁵⁷

- *Subject matter experts stated there are concerns about the effects of marijuana use on the developing brain. They also noted that there is no convincing evidence about whether legalizing marijuana increases use, and increasing use among youth has not been observed. There is more open discussion now, and the perception is that marijuana is less dangerous. Subject matter experts note that the perception is that the credibility of authority figures is weak because historically, young people have received improper messaging about the dangers of marijuana*

use. Legalization will allow for a more honest and trustworthy discussion.

An adult-use regulated marijuana program should prohibit use by youth (individuals under 21). At the same time, there should be an emphasis on education that addresses adolescents' perceptions of the risks, benefits, social norms, and peer influences surrounding marijuana and highlights safety and harm reduction. A regulated marijuana program should implement strategies to reduce youth use of marijuana.

Since marijuana is the most commonly used illegal substance,⁵⁸ people who have tried other substances also are likely to have tried marijuana and alcohol. The majority of individuals who use marijuana do not try other illicit drugs.⁵⁹ Additionally, an individual's environment, genetics and social context are important in understanding an individual's propensity to use substances and develop a substance use disorder.⁶⁰ In a study of initiation into marijuana use which utilized twins to control for genetic factors, researchers found that causal conclusions cannot be drawn related to initiation into marijuana use. This study also found that early regular use of tobacco and alcohol were the two factors most consistently associated with later illicit drug use.⁶¹

- *Subject matter experts stated that the research community generally does not recognize the premise that marijuana leads to the use of other substances as a legitimate or plausible assertion.*

Legalizing marijuana results in a reduction in the use of synthetic cannabinoids/novel psychoactive substances.

The Global Drug Survey indicated that countries that decriminalize marijuana have lower prevalence rates of synthetic marijuana use.⁶² Synthetic cannabinoids are compounds that are sprayed on plant material and purchased for smoking as a "legal high." THC is a partial agonist at the cannabinoid receptor, while these

compounds are full agonists and more potent. Therefore, while the effects are often somewhat like marijuana, the adverse effects can be far more severe, including delirium, lethargy and coma, seizures and hallucinations.⁶³ Other compounds may also be in the mix. For example, in April, there were deaths from these products.⁶⁴ There is disagreement between some experts about the effect legalization will have on synthetic cannabinoid use. However, it is clear that it is often chosen to avoid detection in urine testing.⁶⁵ One survey found that most users prefer natural cannabis.⁶⁶ The synthetic cannabinoid market should be eliminated. A reduction in synthetic cannabinoid availability and use would have particular benefits for individuals with SMI.

A regulated marijuana program should include among its goals reducing the use of synthetic cannabinoids/novel psychoactive substances and ultimately eliminating the synthetic cannabinoid market.

Problematic marijuana use includes Cannabis Use Disorder and Cannabinoid Hyperemesis Syndrome.

There is a lack of consensus as to what percentage of individuals who use marijuana develop some form of dependence, but estimates range from 8.9 percent to 30 percent of the population who uses marijuana.^{67,68} The risk factors for a poor outcome are unclear. However, it will be important to ensure access to treatment, support and care when necessary.

The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), includes criteria to diagnose Cannabis Use Disorder. Cannabis Use Disorder is problematic marijuana use that impedes an individual's quality of life and tolerance to marijuana, and use of marijuana continues despite awareness of physical or psychological problems attributed to use.⁶⁹ Estimates of Cannabis Use Disorder prevalence vary from 2.5 percent to 6.3 percent, and most cases are not treated.⁷⁰ Data indicates that Cannabis Use Disorder is more common among people diagnosed with and treated for mental illnesses. Psychotherapy can be used to

treat Cannabis Use Disorder, and marijuana legalization across the country has led to more dialogue and research around the efficacy and availability of such treatment.⁷¹

It is important to ensure that experts in the field of substance use disorder do not conflate the treatment of Cannabis Use Disorder with other substance use disorders. Every effort should be made in a regulated marijuana program to avoid tobacco and alcohol industry participation.

Cannabinoid Hyperemesis Syndrome can also occur due to heavy use of marijuana and presents with episodes of severe nausea and cyclical vomiting. Symptoms dissipate when marijuana use is stopped. More research is required to better understand why marijuana has antiemetic properties, yet it can elicit this response.⁷² An analysis of the medical records of 1,571 patients with the characteristic cyclical vomiting of the syndrome indicated that approximately 98 (6 percent) had Cannabinoid Hyperemesis. Further research is needed to truly identify prevalence of the syndrome.⁷³

- *Subject matter experts noted that a framework of regulation could support a more appropriate level of treatment for marijuana use that focuses on harm reduction. Legalization could result in more effective partnerships in communities throughout the State. Subject matter experts in substance use services provided data on marijuana treatment admissions from two states that have legalized marijuana. According to the Colorado Department of Human Services, Office of Behavioral Health, marijuana treatment admission rates in Colorado increased each year between 2011 and 2015 but declined significantly during 2016. According to the Washington State Department of Social and Health Services, Division of Behavioral Health and Recovery, marijuana treatment admissions in Washington State declined each year between 2012 and 2015.*

The expertise of substance use specialists will be critical in addressing the issues associated with problematic marijuana use, and resources must be directed to treatment, support and care when

needed. The identification of persons who might need assistance with their marijuana consumption and referral to treatment centers or other supportive services should be a component of a regulated marijuana program. In addition, education and labeling would allow individuals to self-select lower potency items/products with higher CBD/lower THC. Education and labeling should be used to support consumer choice and reduce harm.

The NYS Medical Marijuana Program would adapt to coordinate with a regulated marijuana market.

New York State's Medical Marijuana Program has almost 1,700 registered providers and serves 59,653 certified patients. In the two years since the Medical Marijuana Program was implemented, there have been 27 reported adverse events out of about 300,000 transactions. None resulted in death, and most persons changed to another product without further incident.

As part of the planning for the potential regulation of marijuana, it will be important to re-examine the State's Medical Marijuana Program to ensure access for anyone in need and determine the changes necessary to ensure both programs address their defined objectives. In addition, the State will evaluate information from the eight states (and Washington, D.C.) that currently operate both medical and recreational marijuana programs to determine how they assure patient safety. Individuals who could benefit from medical marijuana should work with a provider to determine if they should utilize the Medical Marijuana Program.

- ***Subject matter experts noted that regulated marijuana program participants who would benefit from medical advice and support can be transitioned to the Medical Marijuana Program. A 2018 study of health conditions and motivations for marijuana use among young adult medical marijuana patients and non-patient marijuana users in Los Angeles found that a notable proportion of non-patients reported health problems that might qualify them for the medical marijuana program.***⁷⁴

A regulated marijuana program must provide education on the assistance that is available in the Medical Marijuana Program to ensure populations that need medical guidance and support have the information necessary to access the program. Growing the medical program while implementing a regulated marijuana program will reduce the risks of legalizing marijuana for individuals who require medical guidance.

II. Criminal Justice and Public Safety

Criminalization of marijuana has not curbed marijuana use despite the commitment of significant law enforcement resources.

Marijuana use has remained relatively stable nationally since 2002, with minor changes.

Criminal records impede New Yorkers' lives.

Statewide, New York's marijuana arrest rate of 535 arrests per 100,000 people was the highest of any state in 2010 and double the national average. That year, there were 103,698 marijuana-possession arrests in NYS – 29,000 more than Texas, the state with the next highest total.⁷⁵ The impact of low level marijuana offenses extends beyond utilization of law enforcement and criminal justice resources. Individuals who have a criminal record often face challenges throughout their lives accessing gainful employment and qualifying for federal housing.⁷⁶ Marijuana-related convictions have a lasting impact on the lives of individuals and their families.

Marijuana prohibition results in disproportionate criminalization of certain racial and ethnic groups.

Across the country, individuals who are Black are nearly four times more likely than individuals who are White to be arrested for marijuana possession, despite data showing equal use among racial

groups.⁷⁷ Stop and Frisk data from NYC presented in a 2013 report from the NYS Office of the Attorney General demonstrated that there were racial disparities in case outcomes among those stopped and arrested. Individuals who are White who were identified by Stop and Frisk were almost 50 percent more likely than individuals who are Black to have an arrest end in an Adjournment in Contemplation of Dismissal, meaning they avoided a conviction.⁷⁸ While marijuana arrests have dropped significantly in New York City since 2014, NYS Division of Criminal Justice Services data demonstrate that 86 percent of the people arrested for marijuana possession in the fifth degree^{vi} in 2017 were people of color; 48 percent were Black, and 38 percent were Hispanic. Only nine percent were White.⁷⁹

- *Subject matter experts noted one of the biggest drivers of racial disparities in criminalization and incarceration rates is marijuana, and the best way to address it is to legalize marijuana. A great majority of arrests are for violations or misdemeanors that most people no longer view as criminal behavior. It is rare that these arrests lead to the discovery of guns or violent crimes. Subject matter experts also noted that continued prohibition of public consumption will reduce the impact of regulated marijuana on arrests. They highlighted a recent media report that described an analysis of NYC police data which found that while marijuana-related arrests have dropped, across NYC, individuals who are Black were arrested on low-level marijuana charges at eight times the rate of White, non-Hispanic people over the past three years. Individuals who are Hispanic*

were arrested at five times the rate of individuals who are White.

Incarceration has a negative impact on families and communities.

Arrests and incarceration negatively impact the health of communities and individuals by destabilizing families, hindering access to education and health care, lowering employment opportunities, increasing poverty, and limiting access to housing, particularly in low-income communities of color where arrests are concentrated despite equivalent rates of marijuana use across racial groups. Incarceration of family members destabilizes families and is considered an adverse childhood experience (ACE)^{vii}, which is associated with decreased health-related quality of life (HRQOL) into adulthood.⁸⁰ Research indicates that incarceration also has an impact on community health in many areas (including teenage pregnancies and sexually transmitted infections).⁸¹

- *Subject matter experts emphasized the need to address the economy of the unregulated market. Regulating marijuana would provide an opportunity to direct resources to workforce development and job creation. Subject matter experts representing law enforcement said that rather than spending time on marijuana arrests, police could devote more time to other aspects of their work, such as community policing and building trust.*

^{vi} Persons are guilty of criminal **possession of marijuana in the fifth degree** when they knowingly and unlawfully possess: 1. marijuana in a public place and such marijuana is burning or open to public view; or 2. one or more preparations, compounds, mixtures or substances containing marijuana and the preparations, compounds, mixtures or substances are of an aggregate weight of more than twenty-five grams. Criminal possession of marijuana in the fifth degree is a class B misdemeanor. (New York Penal Law §221.10)

^{vii} **Adverse childhood experiences (ACEs)**, according to the Substance Abuse and Mental Health Services Administration (SAMHSA), are stressful or traumatic events, including abuse and neglect. They may also include household dysfunction such as witnessing domestic violence or growing up with family members who have substance use disorders. ACEs are strongly related to the development and prevalence of a wide range of health problems throughout a person's lifespan, including those associated with substance misuse.

Resources should be directed to community reinvestment in health care, education and workforce development.

There has been no increase in violent crime or property crime rates around medical marijuana dispensaries.^{VIII,82}

Concerns exist around the possibility that there could be an increase in crime, specifically robberies and burglaries, because sale of marijuana is a cash business. However, a representative of the State's Medical Marijuana Program, which is a cash-only business, stated that there have been no robberies or adverse impact in communities where dispensaries are located.

- *Subject matter experts emphasized the possibility of a reduction in violent crime due to the substantial reduction in the unregulated market, which would lead to a decline in home invasions associated with illegal marijuana and the associated violence. Law enforcement subject matter experts noted that inhabitants of homes involved in the unregulated market install barricades and traps, which present a danger to law enforcement. In addition, some marijuana is still sold by gangs, and that business model is toxic to neighborhoods.*

A regulated marijuana program should monitor crime rates around dispensaries and address instances that may arise.

Marijuana possession is the fourth most common cause of deportation nationally.⁸³

Federal law holds jurisdiction over the possession of marijuana for immigrants, even in states that have legalized. Furthermore, a non-citizen who admits to an immigration official that they possess marijuana can be denied entry into the United States, or their application for lawful status or naturalization may be denied. Depending on the circumstances, it can make a lawful permanent resident deportable. This is true even if the conduct was permitted under state law, the person never was convicted of a

crime, and the conduct took place in their own home.⁸⁴

Conclusions cannot be drawn from the existing research on the impact of marijuana use on motor vehicle traffic crashes (MVTc).

A primary concern of law enforcement is the possibility of increased impaired driving and car crashes in a regulated marijuana environment. In the last 40 years, law enforcement has made great strides in making highways safe. According to law enforcement representatives, in 1973, 35 percent of motorists who were stopped had alcohol in their blood, and 7.5 percent exceeded the legal limit. Today, only eight percent of motorists who are stopped have alcohol in their blood, and only 1.5 percent exceed the legal limit.

- *Subject matter experts corroborated the concern that marijuana can lead to impairment and discussed the effective anti-DWI efforts that can be expanded to include education about driving while under the influence of marijuana. Law enforcement has changed the cultural dialog on drinking and driving, and their expertise will be critical in effectively addressing the issues of driving while impaired from marijuana. There was consensus that resources must be made available to support education and address law enforcement budgetary needs with the establishment of a regulated marijuana program.*

Research indicates that marijuana use by drivers is associated with impaired judgment, motor coordination and reaction time.⁸⁵ A meta-analysis suggests that marijuana use by drivers is associated with an increased risk of involvement in motor vehicle crashes.⁸⁶ However, three years after the legalization of regulated marijuana in Colorado, motor vehicle crash rates overall were not statistically different, although this evidence is still preliminary.⁸⁷

able to advise customers on the strain or type of marijuana best suited for their needs.

^{VIII} **Dispensaries** are stores from which marijuana is sold to consumers. Individuals who work at these stores are

Few states collected pre-legalization baseline data to use as a comparator for evaluation purposes. States that have regulated marijuana have an inability to conclusively state the role that marijuana has played in traffic safety. Data from the National Highway Transportation Administration's Fatality Analysis Reporting System on crashes contain the caveats that they cannot be reliably compared across or within jurisdictions or across years.⁸⁸

The number of drivers using marijuana has been increasing. The National Roadside Survey conducted at 60 sites around the country found that THC was by far the most prevalent drug detected in their sample of drivers. In 2007, 8.6 percent of drivers tested positive for THC. This increased to 12.6 percent in 2013-14, representing a 48 percent increase in the prevalence of drivers testing positive for THC. Fortunately, the percentage of drivers testing positive for alcohol declined from 12.4 percent in 2007 to 8.3 percent.⁸⁹ There is no further funding for these studies, and they cannot be used to produce state-specific data.

Studies of the contribution of marijuana to MVTC have had varied results. Two meta-analyses reported near doubling of the risk of fatal crash regardless of the presence of alcohol or other drugs.^{90,91} Another study examining similar data found a non-significant contribution of marijuana to crash risk when the model also accounted for the presence of other drugs.⁹² Unfortunately, available data is flawed by inconsistencies in both collection and analyses of body fluid samples and descriptions of demographics and crash types.⁹³

There are questions about whether presence of THC in an individual's blood stream is an indicator of impairment. The National Highway Traffic Safety Administration⁹⁴ and the AAA Foundation for Traffic Safety⁹⁵ have both made the distinction that unlike alcohol, presence of THC in an individual's blood stream does not equate to impairment. Peer-reviewed literature and major national

organizations refute the fact that THC in the bloodstream detects impairment.

There are challenges in measuring impairment from the effects of marijuana.

Challenges exist with drug testing methodology and analysis, including risk of inaccuracy (false positives and false negatives), specimen contamination that may occur along the chain of custody, and issues with storage.

In testing for impairment by alcohol, there is a strong correlation between breath/blood levels and impairment, allowing for laws to be set according to these measurements. Testing for marijuana use is more complicated. There is currently no breathalyzer for roadside testing for marijuana use.^{ix} Urine testing can only detect an inactive metabolite which may be present for days or weeks after use. Blood levels are more accurate. However, this is an invasive test requiring several legal steps. The THC levels drop in the time it takes to go from the roadside to the blood draw. Furthermore, there is no clear correlation between the level of THC in the blood and impairment. Due to the lipid-solubility of THC, a frequent marijuana user may have measurable THC in their blood, even if they have not used in several days and are not necessarily impaired.⁹⁶ The Joint Guidance Statement of the American Association of Occupational Health Nurses and the American College of Occupational and Environmental Medicine⁹⁷ reviewed the evidence and suggested that a limit of 5 ng/mL of THC measured in serum or plasma would allow employers to identify potentially impaired employees yet also notes a medical examination focused on identifying impairment is always recommended.

Data on the impact of legalization in states that have passed laws is useful, but it must be noted

^{ix} A product is under development albeit the timeline is unknown.

that not all drivers arrested or in fatal crashes are tested for alcohol and/or drugs. The selection bias may lead to over- or under-estimating the impact.

A study comparing motor vehicle-related fatalities in Washington and Colorado to eight similar states found that three years after marijuana legalization, changes in motor vehicle fatality rates were not statistically different from those in similar states without regulated marijuana.

Medical marijuana has been increasing in availability since 1996 when California passed the first law. The number of California drivers killed in crashes that tested positive for drug involvement decreased nine percentage points, from the 2009-2013 average of 28 percent to 19 percent in 2015 (THC is not broken out).⁹⁸

While existing information suggests a lower impact than might have been expected, legalization of adult use of marijuana raises valid concerns about traffic safety.

Representatives of law enforcement provided a December 2017 study conducted by the State University of New York, Rockefeller College of Public Affairs and Policy, Institute for Traffic Safety Management and Research, on drug involvement in fatal and personal injury (F&PI) crashes on NYS roadways from 2012 to 2016. The analysis found that although less than one percent of all F&PI crashes each year were drug related, the number of drug-related F&PI crashes increased 20 percent over the five years from 2012 to 2016, and 26 percent of all fatalities in 2016 were drug related, up from 18 percent in 2012-2014. While the study examined the extent to which crashes on New York State's roadways involve drugs, it did not examine the extent to which drug-related crashes involved marijuana use.

Representatives of law enforcement indicated that in Washington State, six months prior to the legalization of marijuana, 14.6 percent of arrests for

driving while intoxicated were the result of marijuana-impaired driving vs. 21.4 percent after legalization.⁹⁹ They noted that in the last 40 years, law enforcement has worked to remove intoxicated drivers from our roadways and has made great strides in making highways safe. They are concerned that legalizing marijuana will increase impaired driving and car crashes, and there could be loss of progress.

➤ *Subject matter experts noted that the dangers of driving under the influence of alcohol are worse than the dangers of driving under the influence of marijuana. However, there have been mixed reports regarding the impact of regulated use on the increase of traffic accidents and fatalities.*

There will be a budget and workload impact on law enforcement related to determining impairment. Currently, Drug Recognition Experts (DREs) are used to measure roadside impairment. DREs are certified law enforcement officers with experience in DUI^x/drug enforcement who go through extensive training and a certification process. The evaluation the DRE uses to measure impairment is standardized and considers the subject's mental and physical condition to determine if their impairment is due to drug use (or perhaps an underlying medical condition).¹⁰⁰ This method of measuring impairment is resource intensive, and there are few of them. There will be substantial expense associated with increasing the number of DREs. DREs are trained outside of NYS at the expense of NYS law enforcement. While a breathalyzer for THC may be in development, there is currently no technology for determining impairment. Law enforcement expressed concern about launching a legal program hoping that technology will catch up. They noted that developing and validating a screening tool for purposes of establishing an enforcement paradigm is a lengthy and expensive process involving legal challenges, court rulings, and judicial notice.

^x **Driving under the influence of intoxicants (DUI)** can also be referred to as **Driving While Intoxicated (DWI)**.

Advanced Roadside Impaired Driving Enforcement (ARIDE) training is provided to law enforcement personnel as a pre-requisite to DRE training. ARIDE training may be needed for all law enforcement personnel should the decision be made to legalize marijuana use.

Law enforcement raised a concern about drug detection canine units trained to find marijuana. The legalization of marijuana will result in the loss of these dogs, whose training involved significant time and expense. Other states have faced the same situation and have re-assigned their canine units.

There will be budgetary implications for law enforcement associated with training personnel (e.g., ARIDE training), training and certification of a significant number of personnel as DREs, and the impact on canine programs.

- ***Subject matter experts urged State representatives not to view the difficulties in measuring impairment as a barrier to legalization when solutions can be found. They suggested that mechanisms should be sought to reduce the cost of DRE training and improve access, such as conducting training in NYS. Also noted was that most drugged driving is due to the use of opioids and prescription drugs.***

While existing information suggests a lower impact than might have been expected, legalization of adult use of marijuana raises valid concerns about traffic safety. Efforts are in place to expand the monitoring of this risk in NYS. An expansion of education to the public, along with the development of laws and procedures, can assist in reducing the negative impacts.

In conclusion, it will be essential to ensure public safety and the integrity of the program by, among other things:

- Enforcing the under-21 purchasing ban;
- Reducing the illegal market and preventing diversion;
- Ensuring adequate security at cultivation and dispensing facilities;
- Employing a robust monitoring and oversight system with the ability to issue fines for violations and revoke licenses as needed;
- Promoting further study of methods of detecting impaired driving and the impact of legalization of marijuana on the safety of the State's roadways;
- Enhancing the State's successful anti-DWI efforts to include impaired driving;
- Educating the public as to the potential risks of excessive use;
- Imposing fines for providing false identification;
- Determining hours of operation restrictions for retail establishments; and
- Imposing a tracking, reporting and compliance system for the regulated marijuana program.

III. Economic Estimates

The marijuana industry is expanding. As more states develop a regulated marijuana market, the industry is growing substantially, more licenses are issued for dispensaries, and more consumers exit from the unregulated market. Regulating marijuana will create jobs. Industry sources estimate that there are between 165,000 to 230,000 full- and part-time workers in the United States marijuana industry.¹⁰¹

Marijuana regulation could generate long-term cost savings.

Legalizing marijuana is anticipated to lead to a reduction in costs associated with illegal marijuana, including police time, court costs, prison costs and administrative fees.¹⁰² There will be costs associated with the implementation of a regulated marijuana program; however, the revenue generated is likely to sustain the program after the first year.

Regulated marijuana generates tax revenue.

For purposes of this impact assessment, the following analysis of potential tax revenues was

conducted by the DOH and the Department of Taxation and Finance and reviewed by subject matter experts in economic evaluations. It is important to note, however, that the analyses presented here are for illustration purposes, and policymakers may want to consider other approaches.

Estimates of the size of the current illegal market for marijuana in NYS range from \$1.74 billion to \$3.5 billion annually, including sales to NYS residents and tourists. These amounts and the inputs used to derive them provide the basis on which to estimate the potential tax revenues the State may realize from taxing regulated marijuana sales. The methodology incorporates certain economic parameters that illustrate some of the demand- and price-related uncertainties that may be encountered given the presence of the current unregulated market as well as decriminalization and other factors. This analysis is limited to potential State and local tax revenues and does not consider any licensing fees or registration fees that may be imposed on retail sellers.

Methodology

The potential size of the NYS marijuana market was projected by combining estimates of the State's adult residents (age 21 or older) and visitors that use marijuana, the average amount they use annually, and recently reported market prices. Other factors that might affect the estimated price and demand for legal marijuana, including consumers' behavior in the presence of the current illegal market and behavioral changes that could unfold over time as individuals become accustomed to a regulated marijuana marketplace, are also considered. The following estimates of the number of consumers, their marijuana use, and the current reported price are used as the basis for this approach to estimate potential revenues for NYS.

Consumers

The US Census Bureau estimates that the State's population in 2017 was 19.85 million, of which 14.9 million (74.9 percent) are aged 21 or older.¹⁰³ Using NYS-specific data on marijuana use as reported in the 2016 National Survey on Drug Use and Health,¹⁰⁴ the proportion of NYS residents who are marijuana users is estimated to be 8.5 percent, resulting in an estimate of approximately 1.27 million NYS residents who are marijuana consumers.

In addition, tourists and other visitors to the State may purchase marijuana after regulated use is legalized. According to the American Hotel and Lodging Association, there are over 234,000 hotel rooms in the State.¹⁰⁵ Assuming 80 percent occupancy with 1.5 adults per occupied room yields almost 281,000 visitors and other overnight travelers to the State. It is assumed that half of these visitors are international travelers and half are domestic, though it is assumed that 75 percent of the latter are from outside NYS.¹⁰⁶ Further, the proportion of domestic marijuana users is assumed to be the same as the national average (7.6 percent), but a lower proportion (6.7 percent) is applied to derive the number of international users. As a result, it is estimated that there are an additional 20,000 marijuana consumers.

Given that marijuana has been legalized in neighboring states such as Massachusetts and Vermont and is under consideration in New Jersey, this analysis did not include any additional consumers to the calculation of the market.

In total, it is estimated that 1,290,000 consumers would access the legal market the first year after legalization of marijuana.^{x1}

Consumption

Fiscal analysis conducted by Washington and Colorado estimates that the average marijuana user consumes five ounces of marijuana per year, while

^{x1} It is possible that persons may come from other states to NYS to purchase legal marijuana, but that additional demand is not estimated.

the Department of Taxation and Finance used data from the National Survey on Drug Use and Health to estimate that the average marijuana user consumes almost 7.9 ounces of marijuana per year. Both estimates are used in this analysis as a high and low estimate.

Price

The average retail price of marijuana in NYS has been reported as \$270 per ounce for medium quality strains and \$340 per ounce for high quality strains.¹⁰⁷ For this analysis, to derive potential ranges of tax revenues, \$270 per ounce was used as a low end of the illegal market price range and \$340 as the high end of the illegal market price range.

Market Size

Based on inputs and assumptions, purchases of illegal marijuana in NYS are estimated to be about 6.5 to 10.2 million ounces annually. At an average retail price of \$270 per ounce, the market for marijuana is estimated to be approximately \$1.7 billion; at \$340 per ounce, the market is estimated to be approximately \$3.5 billion.

Potential State Tax Revenues

To estimate potential tax revenues, a methodology used by the State Department of Taxation and Finance was followed using \$270 and \$340 prices per ounce. Moreover, noting that usage can change and has changed over time, for low-estimate scenarios, an annual average consumption of 5 ounces per user was used, while 7.9 ounces was used for high-estimate scenarios. As previously noted, this analysis makes certain adjustments to account for changes in demand, including the effect of the illegal market and other non-price effects. These adjustments include:

Legal Market Price: This is the price that the product sells for at retail to the consumer. This price includes production costs and applicable taxes. For this analysis, an increase of 10 percent is used in these calculations.

Price elasticity^{xii}: RAND researchers assume a price elasticity of marijuana consumption or demand of between -0.4 and -1.2, with a point estimate of -0.54.¹⁰⁸ For this analysis, a value of -0.8 was used, which was the midpoint of the range cited by the RAND researchers and others.¹⁰⁹

Non-price effect: RAND researchers note that non-price effects on demand, which arise from reduced risk of arrest, reduced social stigma, lower risk of contaminants or mislabeling, and greater product variety and marketing, can range from 5 percent to 50 percent.¹¹⁰ Five percent was used in these calculations.

Tax rate: The higher the tax rate imposed, the higher the legal market price will be. In turn, a higher legal market price will have a greater price effect, which will result in users less likely to exit the unregulated market. The Tax Foundation recommends that the tax rate not be so high as to prevent elimination of the illegal market.¹¹¹ As of August 2017, marijuana tax rates range from 3.75 percent in Massachusetts to 37 percent in Washington State of the retail price.¹¹² For purposes of this analysis, ranges of potential revenues are presented assuming: 1) imposing the 7 percent retail tax rate currently assessed on medical marijuana as well as a 15 percent marijuana tax rate, and 2) a combined State and local sales tax rate of 8.5 percent for sales outside the Metropolitan Commuter Transportation District (MCTD) and 8.875 percent for sales inside the MCTD. Given these adjustments and the baseline prices and consumption figures that were determined, the chart below summarizes the inputs used to derive the ranges of the first year's potential tax revenues (see Table 1 below).

^{xii} **Price elasticity** is a measure of the responsiveness of quantity demanded to a change in price.

Table 1: Summary of Assumptions & Adjustments for Calculation of First Year Potential Tax Revenues

Illegal market price (estimated average)	\$270 and \$340 per ounce
Illegal market sales (estimated)	6.5 -10.2 million ounces
Estimated illegal market size	\$1.7 billion - \$3.5 billion
Estimated legal market price (excluding taxes)	\$297 and \$374 per ounce
Price elasticity of demand	-0.8
Non-price effect of legalization	+5 percent
Marijuana retail tax rate	7 percent and 15 percent

Based on this analysis, the estimated potential total tax revenue in the first year with a price of \$297 and illegal market consumption of 6.5 million ounces ranges from \$248.1 million (with a 7% tax rate) to \$340.6 million (with a 15% tax rate). The estimated potential total tax revenue with a price of

\$374 and illegal market consumption of 10.2 million ounces ranges from \$493.7 million (with a 7% tax rate) to \$677.7 million (with a 15% tax rate). The table below shows the results of applying these inputs and adjustments (see Table 2 below).

Table 2: Retail Price/Retail Tax

	<u>\$297 per ounce</u>		<u>\$374 per ounce</u>	
<u>Sales and Tax Revenues</u>	<u>7%</u>	<u>15%</u>	<u>7%</u>	<u>15%</u>
Retail Sales	\$1.6 billion	\$1.4 billion	\$3.1 billion	\$2.9 billion
Marijuana Retail Tax	\$110.3 million	\$215.2 million	\$219.5 million	\$428.1 million
State and Local Sales Tax	\$137.8 million	\$125.4 million	\$274.2 million	\$249.6 million
Total Tax revenues	\$248.1 million	\$340.6 million	\$493.7 million	\$677.7 million

This analysis assumes that a portion of sales remain in the illegal market. Over time, the number of users remaining in the illegal market may decline.

The projection of potential tax revenues is a preliminary estimate based on numerous assumptions. Further analyses should account for possible variations in the values of assumptions used here, which reflect uncertainties in pricing, consumption, and the effect of legalization on the unregulated market. This analysis also reflects uncertainty as to whether lower prices resulting from legalization will cause users to move to the regulated market. Further, given that there is some uncertainty in all parameters used in the analyses described here, these point estimate results should be considered careful and reasonable estimates based on the best available literature. As any regulated marketplace unfolds, such analyses should be routinely updated over time.

Tax revenue can support State program initiatives.

According to the Colorado Department of Revenue, marijuana sales generated nearly \$200 million in State tax revenue and license fees in 2016. Colorado's Marijuana Tax Cash Fund is used for school construction, expanded education, drug prevention efforts and law enforcement. Since municipalities have the choice to participate in the legal market, only participating local governments receive money from the Fund.¹¹³ Washington State uses the funds generated from marijuana sales to aid administrative costs, research projects, substance abuse programs, marijuana programs, health care, and the State's general fund. Appendix A, Figure 5 illustrates the use of revenue from regulated marijuana and the employment that resulted from legalized marijuana in the State of Colorado.

- *Subject matter experts agreed that there is potential for substantial tax revenue in NYS, which can be used for the greater good, such as public health, education, transportation, addressing the needs of a changing workforce, and addressing the*

changing budgetary needs of law enforcement. Subject matter experts identified evaluation as a priority, stating that it would be irresponsible if NYS does not add to the knowledge around regulated marijuana programming. The availability of State funding for research would remove some of the limitations associated with research using federal dollars.

NYS should follow certain best practices based on lessons learned in other states in implementing a tax on regulated marijuana use and the differing taxing options. Some states had to lower their initial tax rate since a higher price did not incentivize consumers to move from the unregulated to the legal market. If a significant price difference exists between recreational and medical marijuana, consumers will likely prefer the lower price product which is why the ability to adjust or index tax rates to address realities in the market has proven beneficial. For example, a bill put forward in New Jersey proposes a graduated marijuana retail tax. The retail tax begins at a rate of 7 percent in the first year to encourage consumers to transition from the unregulated market. Over the course of five years, in conjunction with a maturing industry, the tax rate increases to 25 percent.¹¹⁴ Some states overestimated revenue initially, as they did not account for the length of time it takes for a recreational marijuana market to become established, leading to fewer than expected sales.

The three main ways of taxing marijuana are weight-based, price-based and potency-based. A weight based tax is best to be implemented at the producer level and has the advantages of reducing product leakage into the untaxed market, creating a price floor, and allowing for a more stable revenue stream. However, it also incentivizes higher potencies and is more difficult to administer. A retail price-based tax has proven most effective as it is easier to administer and less problematic than a producer or wholesale level tax, but it is a more unstable revenue source. A potency-based tax system best correlates to the level of intoxication (similar to alcohol taxation), yet current testing methods may be inadequate for taxation purposes

and it could be a more complex tax system to establish and administer.

In addition, there are other inherent risks that will impact the amount of potential revenue collected. These include allowing individuals to grow a certain amount of marijuana plants, placing a limit on the amount purchased or allowing localities to ban the sale of marijuana, which will all lead to an increase of marijuana purchased on the unregulated market and will reduce the amount of tax collected. Also, the strains of marijuana and forms permissible will have an impact on sales. The restrictive nature of current regulations on medical marijuana will also need to be addressed, as well as whether there should be a tax break for those using marijuana for medicinal purposes since both will have a direct impact on the tax amount collected.

Tax revenue from regulated marijuana can be used to support program initiatives in areas such as public health education, transportation, research, law enforcement, workforce development and community reinvestment.

IV. Education

Public safety messaging is needed to ensure individuals know about the potential harms of drugged driving.

Individuals who consume marijuana are more likely to perceive the risks of marijuana intoxication while driving as lower than individuals who do not consume marijuana.¹¹⁵ Public safety messaging and ongoing monitoring are required to educate the public.

Marijuana messaging should be tailored to the needs of different key populations including youth/adolescents/young adults and pregnant women.

Prioritization should be given to an educational approach that emphasizes safety, mitigates potential harm, and suggests that youth delay use.¹¹⁶ Evidence suggests that prevention strategies targeting youth can be most effective if they provide honest, science-based information in a non-judgmental and non-punitive manner.¹¹⁷ Enhancing youth skills such as personal responsibility and knowledge is essential. While abstinence must be encouraged, youth should be taught to understand that moderation and self-regulation can mitigate potential harms if they do not abstain.¹¹⁸

Research indicates that states need to address adolescents' perceptions of the risks, benefits, social norms, and peer influences surrounding marijuana use as they implement strategies to reduce youth use of marijuana.¹¹⁹ In Washington State, surveys of 8th and 10th graders indicated that they perceived marijuana as being less harmful after legalization.¹²⁰ The same was not true in Colorado, where there was no change in adolescent perception of harmfulness post legalization.¹²¹

Regulating marijuana enables public health officials to share messages regarding lower risk cannabis use guidelines (LRCUG) to help reduce the potential harms of marijuana consumption.¹²²

In a regulated marijuana program, products can be labeled to indicate the percentages of the various chemical compounds they contain (e.g., CBD vs. THC content) to maximize consumer awareness of potency. Research indicates that issuing guidelines on the following can help ameliorate the potential harms of marijuana use: avoiding combustible use, avoiding use when pregnant, making products with lower potency available, prohibiting youth use, and avoiding consumption of marijuana and tobacco in tandem. Further messaging should be provided to ensure that individuals know about the differences between marijuana use, tobacco use and alcohol use, as well as to ensure that

individuals exercise caution not to consume multiple substances at once.

States with legalized marijuana have conducted extensive educational campaigns as their programs were implemented.

Concerns have been raised by government representatives about the impact of legalized marijuana on the workforce and the need for workforce training. For example, Child Protective Services workers would require training on the appropriate response to a positive screen for marijuana in newborns and mothers if it is no longer illegal. There will be implications for substance use treatment providers. A strategy will be needed for providers who will be required to treat substance use in an environment where marijuana is legal. There is likely to be a need for education for the judiciary and treatment courts.

- ***Subject matter experts noted the need for training for public housing and substance use treatment workers, since marijuana use is punished in a criminalized environment. There would need to be education on dismantling punitive measures.***

Legalization provides an opportunity to educate consumers on what their options are and encourage the use of products with lower doses of THC.

People will be empowered to take more control over their mental and physical health if they are given counsel and guidance. There are opportunities to provide such guidance in a regulated market.

V. Impact of Legalization on Other States

The legalization of marijuana in neighboring jurisdictions raises concerns about both marijuana diversion to NYS from states that have legalized and revenue diversion from NYS to states that have legalized. Several neighboring jurisdictions have legalized marijuana or are likely to legalize soon. Massachusetts, Vermont, Maine and Canada have legalized marijuana. Legalization is under discussion in New Jersey as well.

Regarding diversion of marijuana from states with legal markets, a University of Oregon study demonstrates that areas legalizing marijuana will likely sell sizable quantities of marijuana to individuals from neighboring regions. Oregon opened a regulated market on October 1, 2015, next to Washington State's existing market. The study found that Washington retailers along the Oregon border experienced a 41 percent decline in sales following Oregon's legal market opening. The study found evidence that prior to legalization in Oregon, consumers on the Oregon side of the border were crossing state lines to obtain marijuana in Washington rather than purchase marijuana in Oregon through the unregulated market. This is particularly striking given the fact that obtaining marijuana illegally in Oregon resulted in only a civil fine, whereas crossing state lines to obtain legal marijuana in Washington risked federal felony prosecution. The study suggests that consumers prefer legal, regulated products, perhaps due to the variety of products offered, the presence of safety regulations, and the additional product attribute information stemming from THC and CBD testing.¹²³

Legalization in surrounding jurisdictions could lead to an increase in marijuana possession arrests in border counties in NYS. A Washington State University study examined the "spillover" effects of regulated marijuana legalization in Colorado and Washington on neighboring states without

legalization and found that legalization causes a sharp increase in marijuana possession arrests in border counties of neighboring states relative to non-border counties in these states. Regulating marijuana has no impact on juvenile marijuana possession arrests but is rather fully concentrated among adults.¹²⁴

Notably, unlike other states that shared one border with a state that legalized, New York shares multiple borders with states that have or are considering legalized marijuana (i.e., Massachusetts, Vermont and New Jersey) and one international border (New York shares a border with two Canadian provinces). If marijuana is not legalized, the cross-border effects in NYS are likely to be substantial, involving numerous counties and municipalities.

Legalization in neighboring jurisdictions raises the likelihood of revenue flowing from New York into those jurisdictions. The methodology used in a joint New Jersey Policy Perspective/New Jersey United for Marijuana Reform analysis of revenue implications of legalized marijuana in New Jersey includes estimates associated with non-New Jersey participants, specifically residents of New York and Pennsylvania, in their marijuana marketplace. The projected annual expenditures of New York and Pennsylvania consumers in New Jersey's market is estimated at \$108.7 million.¹²⁵

- *Subject matter experts noted that failure to legalize in NYS could increase unregulated market sales if persons buy marijuana legally in surrounding jurisdictions to re-sell it illegally in NYS.*

VI. Implementation

The overarching goal of regulating marijuana in NYS must be the incorporation of harm reduction strategies. Implementation of a regulated marijuana program will require considerable planning as to the regulatory mechanisms needed to protect public health, provide consumer protection, and ensure public safety. At the same time, a well thought out program should address the social justice issues associated with criminalization, provide opportunity for community revitalization, and establish a system to capture and invest tax revenue. Ultimately, the system should be designed to reduce the utilization of the unregulated market. Implementation of a regulated marijuana program will require legislative and regulatory approaches that address the diverse needs of the State and the differing needs of a regulated marijuana program in rural regions compared to those in urban areas.

A key substantive policy area is the determination of the types of licenses to be granted in a regulated marijuana program. Other states have various sub-classifications of licenses, but they generally fall within classifications such as: cultivation/producer, manufacturing/processor, testing, retail, and distribution. California has 13 types of cultivation licenses alone, varying based on size, indoor, outdoor, nursery, microbusiness, etc.¹²⁶

Massachusetts is prioritizing applicants for licensure to ensure equal opportunities in the regulated market for individuals who meet certain criteria, including ownership by or the provision of services to persons who live in areas of disproportionate impact, employment of residents of areas of disproportionate impact, employment of people with drug-related criminal offender record information who are otherwise employable, and ownership by persons of color.¹²⁷ Many states offer producer licenses at different tiers based on the

canopy^{xiii} of their potential cultivation.¹²⁸ Fee structures for the applications of these licenses and the licenses themselves will also need to be determined. Further consideration is needed to determine who will review and issue licenses and how often they will need to be updated. We recommend that NYS limit the number of licenses initially available and adopt a model of licensure prioritization similar to the Massachusetts model.

In addition to licensure regulations, the State will need to establish further requirements for each step of the supply chain. It is imperative to decouple the regulated marijuana program from both the alcohol and tobacco industries, thus ensuring that they are not involved in any step along the supply chain. With respect to cultivation and production, regulations will be required to control the amount and location of production (e.g., indoors or outdoors). With respect to testing, guidance will be needed for laboratories to ascertain the breakdown of THC and CBD content and to test for mold and other contaminants. Regulations will also be required to address how marijuana will be retailed, including the types of products that can be sold in the market and locations of sales dispensaries (e.g., distance from schools, churches, etc.). Alaska, Massachusetts, and Nevada have established regulations to ensure that substances would not be plainly visible to the public from outside retail establishments.

Additionally, regulations will be required to determine what will be permitted for specific products. This includes detailed discussion regarding the appropriate amount of THC per serving size and what types of products would be permitted (flower, vaporization, edibles, tinctures, topicals, etc.). We recommend that NYS place limits on the amount of THC and the types of products offered for sale. We recommend that the amount of marijuana that may be purchased be limited to a one-ounce maximum. Other states, such as Oregon, have conducted focus groups and established

guidance solely regarding the specifics of product packaging. Requirements regarding child proofing and tamper proofing will also need to be determined. To ensure packaging is not attractive to minors, we recommend that the program include guidelines to standardize the industry (such as avoiding cartoon-like imagery or requiring that any products that may look like candy be contained in opaque packaging). We also recommend that processes be established to approve packaging for marijuana products, and guidelines will be required to set forth specific packaging parameters.

Another key substantive policy area is the taxation of regulated marijuana products, which has many implications as taxation dictates the price of the products in the regulated market, influencing consumer behavior. As discussed in the *Economic Estimates* section of this report, price point is crucial because if it is too high, consumers will not transition from the unregulated market to the regulated market.¹²⁹ Decisions will need to be made about where in the production chain excise taxes are placed and to what extent each level of production should be taxed. We recommend that the state begin with low taxation (e.g. between 7 and 10 percent.) NYS will need to determine if vertical integration will be permitted. NYS should consider lessons learned in other states. Washington State initially had higher tax rates and restructured their taxation after the realization that the taxes were cost prohibitive. Colorado, Washington, and Oregon have all taken steps to reduce their marijuana tax rates.¹³⁰ Ensuring that NYS has adequate pricing will require careful and intentional deliberations with numerous stakeholders. The economic estimates in this assessment are based on numerous assumptions and are intended to provide a framework for further discussion.

A regulated marijuana program should ensure that workforce needs are met. Safe working environments should be established for individuals

^{xiii} Washington State defines **canopy** as the square footage dedicated to live plant production, such as maintaining mother plants, propagating plants from seed to plant tissue, clones, vegetative or flowering area. Plant

canopy does not include areas such as space used for the storage of fertilizers, pesticides, or other products, quarantine, office space, etc.

in the new regulated market. Labor protections will need to address both cultivation and retail and include special considerations for indoor and outdoor cultivation. Businesses in Colorado's marijuana industry must comply with the regulations and recordkeeping requirements of the Occupational Safety and Health Administration (OSHA). Colorado's *Guide to Worker Safety and Health in the Marijuana Industry: 2017* delineates the federal OSHA requirements, state regulations, and a best practice guide to ensure worker safety. Specific protections apply to different classifications of occupations including cultivators, trimmers, technicians, administrators, edible producers, and transporters. Colorado outlined protections against biological hazards (i.e., mold and allergens) and chemical hazards (i.e., pesticides, nutrients, and disinfectants) and laid out specific workers' rights for individuals working in any component of the marijuana industry. We recommend that NYS similarly adopt regulations regarding training for individuals working in the industry.

A regulated marijuana program should consider mandating data collection and evaluation of its impact. Information obtained from ongoing studies should be used to further refine the State's regulatory approach and inform program design so NYS can respond to needs as they arise. NYS has an opportunity to be a leader in monitoring the use of marijuana and gathering information about benefits and potential harm to inform the implementation of harm reduction strategies. We recommend that NYS establish a comprehensive system of data collection at point-of-sale.

A regulated marijuana program will require detailed guidance in the areas of public safety and education. Enforcement regulations will need to be created for general oversight, inspection, and penalties for participants who engage in unregulated sale or use. We recommend that NYS create statewide educational campaigns to continue ensuring the safety of the State's roads and public safety messaging that is targeted to specific populations. Peer education will be essential, and it will be important to develop tools to assist parents in communicating with their children. Other states with regulated marijuana programs have

established educational campaigns to notify the public of the details of the legislative change and educate them about marijuana use. NYS should consider creating statewide educational campaigns to prepare the public and inform consumers before dispensaries are operational. As noted in the *Education* section of this report, educational campaigns should consider key populations, such as individuals with or at risk for severe mental illness, youth, and pregnant and breastfeeding women.

We recommend NYS address prior criminal convictions for marijuana possession. Some jurisdictions are working toward expunging previous drug-related offenses, such as San Francisco and San Diego, where district attorneys announced that they will review, recall, resentence, potentially dismiss, and seal misdemeanor and felony marijuana convictions. Seattle's district attorney made a similar announcement. This will have lasting social justice implications, as there has been disproportionate criminalization of certain racial and ethnic groups. We recommend NYS expunge the criminal records of individuals with marijuana-related offenses.

All states that have legalized have had to address specific and important issues when implementing a regulated marijuana program. An analysis of each state's decisions with respect to the detailed regulations they have issued may be found in *Appendix C*. Similar regulations and guidance will need to be created in NYS through careful planning with policy makers and subject matter experts if NYS moves toward implementation.

It is important to understand that effective implementation and regulation will be an ongoing process that will take continued work from State and local officials. Every step of a regulated marijuana program will require planning and regulation. Thoughtful input will be required on the development of legislation, regulations, policies, and implementation strategies. In addition, precise technical guidelines will need to be developed in public health, public safety, and consumer protection to ultimately ensure the program is established with a harm reduction approach.

Participation of stakeholders in developing the parameters of a regulated marijuana program is important. Such stakeholders could include subject matter experts from throughout the State and government representatives of public health, mental health, substance use, taxation and finance, law enforcement, and public safety. Moving forward, it is recommended that NYS form a workgroup of subject matter experts with relevant public health expertise to consider the nuances of a regulated marijuana program, review existing legislation, and make recommendations to the State that address each of these areas in a manner that is consistent with the harm reduction goal.

The process of legalization and regulation will be dynamic. Legalization efforts should be clear on the goals they are setting out to achieve for the people of NYS. Policymakers will need to balance competing priorities in a way that maximizes

program effectiveness. Policymakers can learn lessons from approaches taken by other states and study what has worked and what has not.

There are tradeoffs inherent to the transition from an unregulated to a regulated market. It is imperative that a regulated marijuana program contain all necessary safeguards and measures to limit access for individuals under 21, minimize impaired driving, provide education and tailored messaging to different populations, and connect people to treatment if needed. During this transition, the purpose of public policy will be to reduce the harms associated with marijuana criminalization, minimize the harms associated with a regulated marijuana program, and maximize the benefits of regulation.

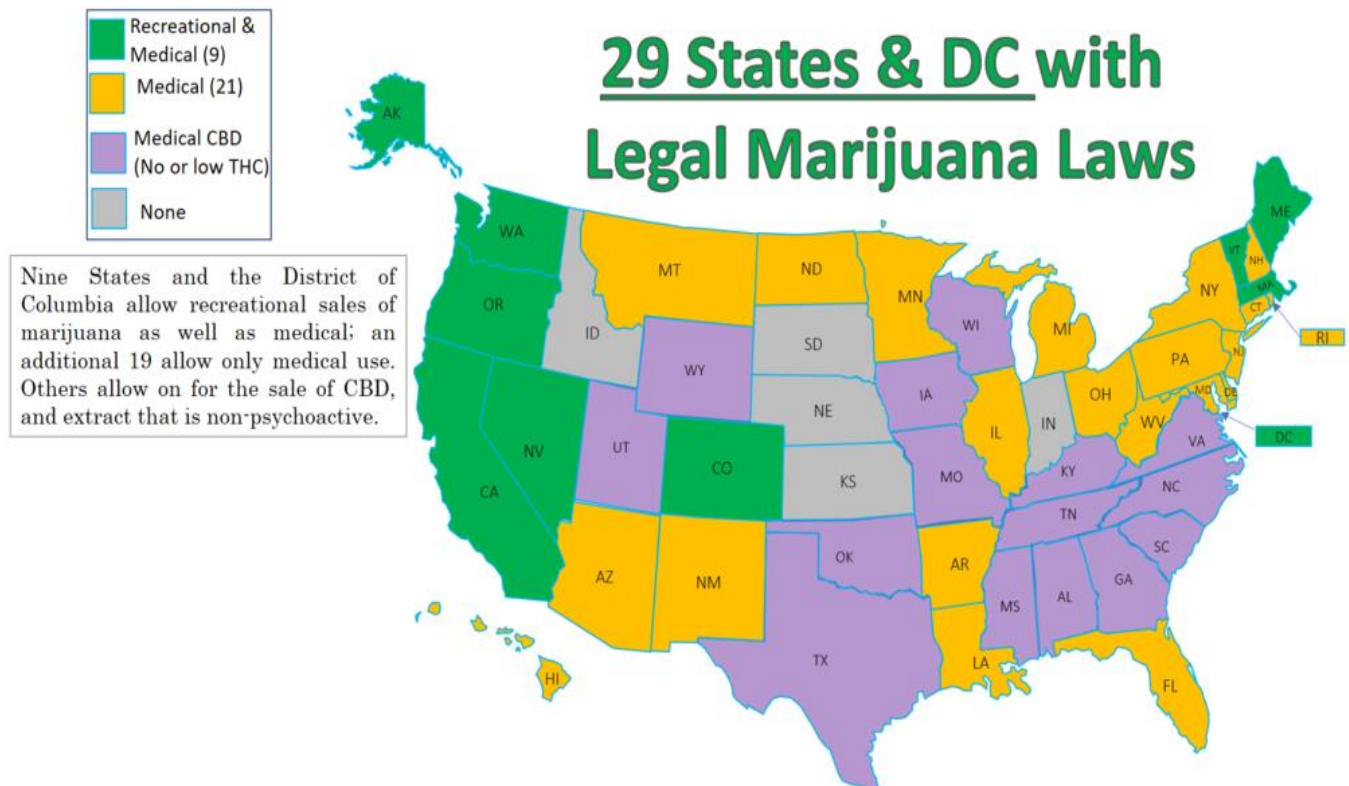
VI. Conclusion

The positive effects of a regulated marijuana market in NYS outweigh the potential negative impacts. Areas that may be a cause for concern can be mitigated with regulation and proper use of public education that is tailored to address key populations. Incorporating proper metrics and indicators will ensure rigorous and ongoing evaluation.

- Numerous NYS agencies and subject matter experts in the fields of public health, mental health, substance use, public safety, transportation, and economics worked in developing this assessment. No insurmountable obstacles to regulation of marijuana were raised.
- Regulation of marijuana benefits public health by enabling government oversight of the production, testing, labeling, distribution, and sale of marijuana.¹³¹ The creation of a regulated marijuana program would enable NYS to better control licensing, ensure quality control and consumer protection, and set age and quantity restrictions.
- NYS would be one of the largest potential regulated marijuana markets in the United States. As such, there is potential for substantial tax revenue in NYS, which can be used to help support program initiatives in areas such as public health, education, transportation, research, law enforcement and workforce development. Tax revenues can also support community reinvestment in health care and employment.
- Historically, marijuana criminalization has had a profound impact on communities of color and has led to disproportionate targeting of certain populations for arrest and prosecution. The over-prosecution of marijuana has significant negative economic, health, and safety impacts that have disproportionately affected low-income communities of color. Legalization of marijuana will address this important social justice issue.
- The development of this assessment involved discussions of numerous issues that relate to implementation of a legalized marijuana program, rather than the impact. Much of the impact of a regulated marijuana program is contingent on program implementation. While some implementation issues have been described in this assessment, further exploration will be required should NYS move toward legalization.

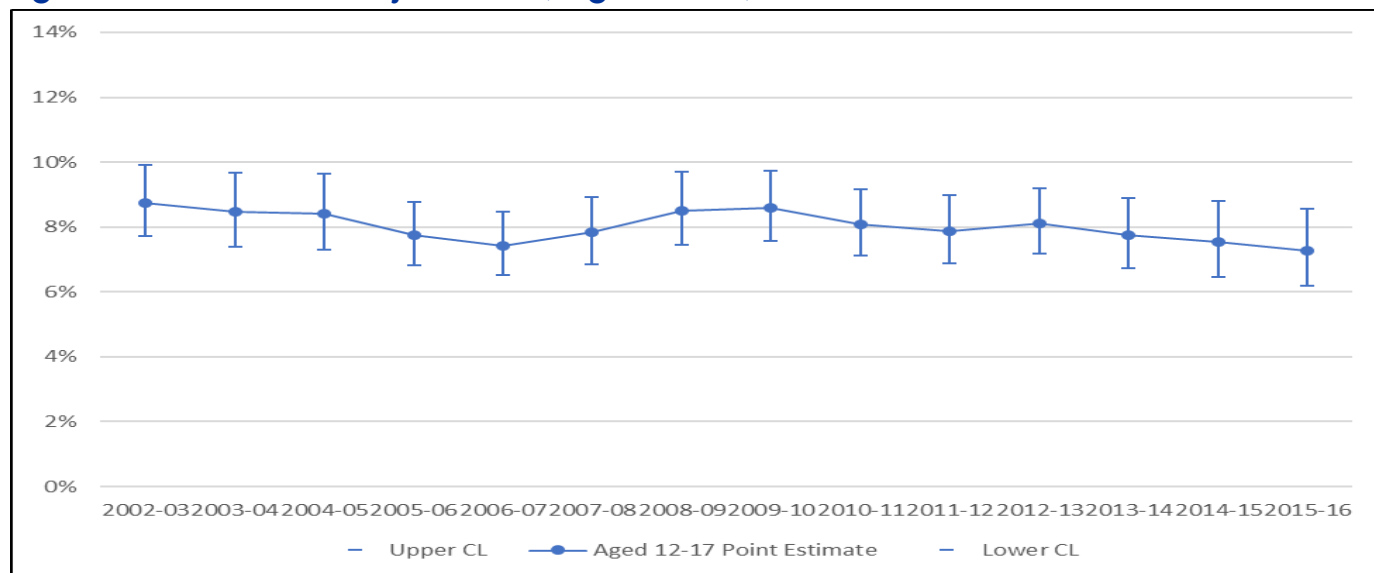
Appendix A: Figures, Graphs and Charts

Figure 1: Map of State Marijuana Policies



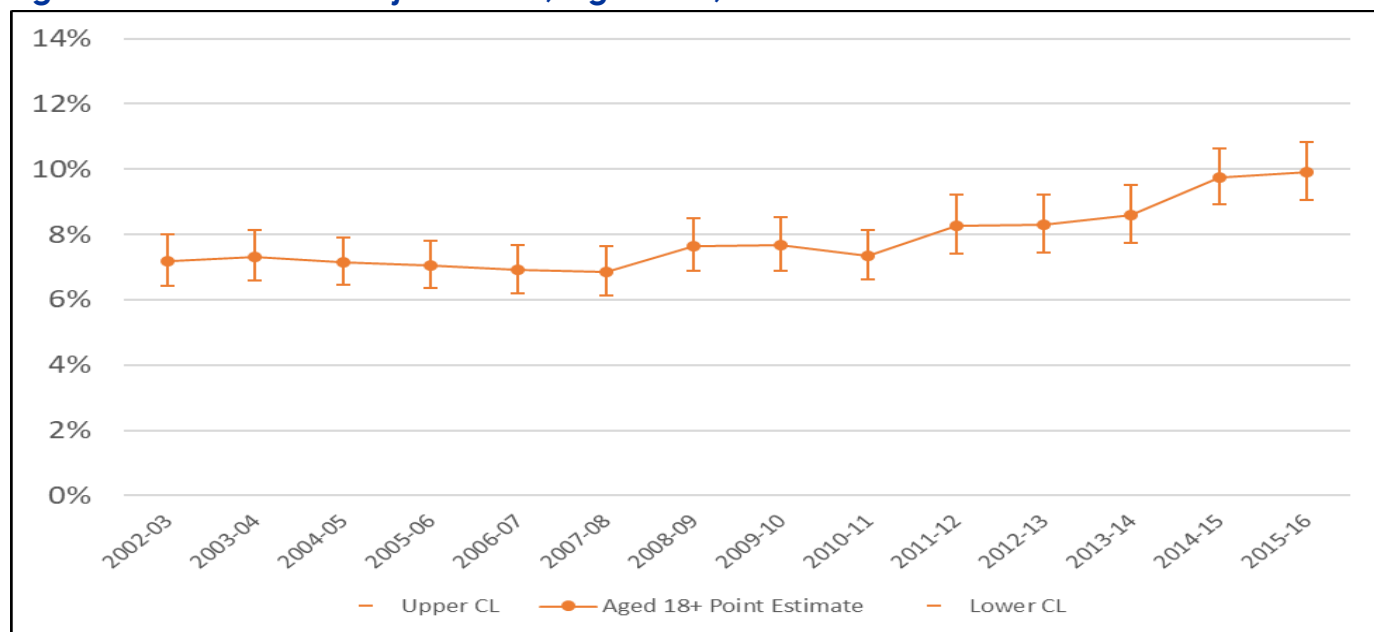
Source: "U.S. Legalized Cannabis Map." *Cannabis Compliance*, tgunthergroup.com/2017-cannabis-map/.

Figure 2: Past Month Marijuana Use, Aged 12-17, New York



Source: SAMHSA National Survey on Drug Use and Health, 2002 – 2016.

Figure 3: Past Month Marijuana Use, Aged 18+, New York



Source: SAMHSA National Survey on Drug Use and Health, 2002 – 2016.

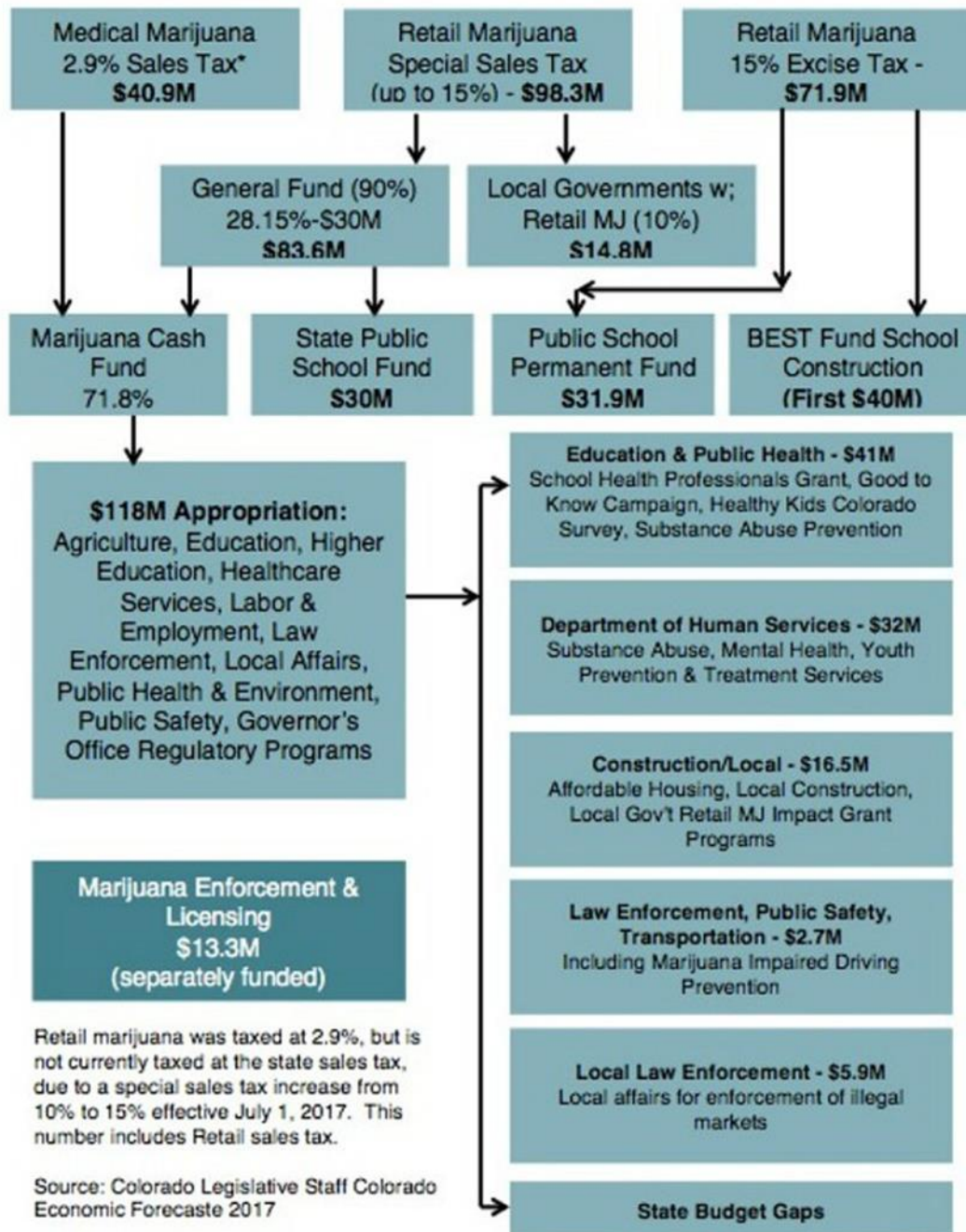
Figure 4: Colorado Economic Development and Job Creation

Figure 6.
Employment
estimates by type
in Colorado, 2015

Source:
Marijuana Policy Group.



Figure 5: Marijuana Tax Revenue Usage in Colorado



Appendix B: Annotated Bibliography

Introduction

The annotated bibliography that follows contains a select group of journal articles related to marijuana use and the impact of legalization. This bibliography was developed by conducting an extensive search of English-language literature indexed in *PubMed* (<http://pubmed.gov>), an online database of biomedical journal citations and abstracts created by the U.S. National Library of Medicine and *Google Scholar*, an online search engine that provides journal articles and research from academic publishers, professional societies, universities, and other web sites.

Many of the articles selected contain overlapping information touching on some or all of the following focus areas: Health, Criminal Justice and Public Safety, Economic, and Education.

Health

Adejumo, A. C., Ajayi, T. O., Adegbala, O. M., Adejumo, K. L., Alliu, S., Akinjero, A. M., . . . Bukong, T. N. (2018). Cannabis Use is Associated with Reduced Prevalence of Progressive Stages of Alcoholic Liver Disease. *Liver International*. doi:10.1111/ liv.13696.

Background: Abusive alcohol use has well-established health risks including causing liver disease (ALD) characterized by alcoholic steatosis (AS), steatohepatitis (AH), fibrosis, cirrhosis (AC) and hepatocellular carcinoma (HCC). Strikingly, a significant number of individuals who abuse alcohol also use Cannabis, which has seen increased legalization globally. While cannabis has demonstrated anti-inflammatory properties, its combined use with alcohol and the development of liver disease remain unclear. **Aim:** The aim of this study was to determine the effects of cannabis use on the incidence of liver disease in individuals who abuse alcohol. **Methods:** We analysed the 2014 Healthcare Cost and Utilization Project-Nationwide Inpatient Sample (NIS) discharge records of patients 18 years and older, who had a past or current history of abusive alcohol use (n = 319 514). Using the International Classification of Disease, Ninth Edition codes, we studied the four distinct phases of progressive ALD with respect to three cannabis exposure groups: non-cannabis users (90.39%), non-dependent cannabis users (8.26%) and dependent cannabis users (1.36%). We accounted for the complex survey sampling methodology and estimated the adjusted odds ratio (AOR) for developing AS, AH, AC and HCC with respect to cannabis use (SAS 9.4). **Results:** Our study revealed that among alcohol users, individuals who additionally use cannabis (dependent and non-dependent cannabis use) showed significantly lower odds of developing AS, AH, AC and HCC (AOR: 0.55 [0.48-0.64], 0.57 [0.53-0.61], 0.45 [0.43-0.48] and 0.62 [0.51-0.76]). Furthermore, dependent users had significantly lower odds than non-dependent users for developing liver disease. **Conclusions:** Our findings suggest that cannabis use is associated with a reduced incidence of liver disease in alcoholics.

Bachhuber, M. A., Saloner, B., Cunningham, C. O., & Barry, C. L. (2014). Medical Cannabis Laws and Opioid Analgesic Overdose Mortality in the United States, 1999-2010. *JAMA Internal Medicine*, 174(10), 1668. doi:10.1001/jamainternmed.2014.4005.

Importance: Opioid analgesic overdose mortality continues to rise in the United States, driven by increases in prescribing for chronic pain. Because chronic pain is a major indication for medical cannabis, laws that establish access to medical cannabis may change overdose mortality related to opioid analgesics in states that have

enacted them. **Objective:** To determine the association between the presence of state medical cannabis laws and opioid analgesic overdose mortality. **Design, Setting, and Participants:** A time-series analysis was conducted of medical cannabis laws and state-level death certificate data in the United States from 1999 to 2010; all 50 states were included. **Exposures:** Presence of a law establishing a medical cannabis program in the state. **Main Outcomes and Measures:** Age-adjusted opioid analgesic overdose death rate per 100 000 population in each state. Regression models were developed including state and year fixed effects, the presence of 3 different policies regarding opioid analgesics, and the state-specific unemployment rate. **Results:** Three states (California, Oregon, and Washington) had medical cannabis laws effective prior to 1999. Ten states (Alaska, Colorado, Hawaii, Maine, Michigan, Montana, Nevada, New Mexico, Rhode Island, and Vermont) enacted medical cannabis laws between 1999 and 2010. States with medical cannabis laws had a 24.8% lower mean annual opioid overdose mortality rate (95% CI, -37.5% to -9.5%; $P = .003$) compared with states without medical cannabis laws. Examination of the association between medical cannabis laws and opioid analgesic overdose mortality in each year after implementation of the law showed that such laws were associated with a lower rate of overdose mortality that generally strengthened over time: year 1 (-19.9%; 95% CI, -30.6% to -7.7%; $P = .002$), year 2 (-25.2%; 95% CI, -40.6% to -5.9%; $P = .01$), year 3 (-23.6%; 95% CI, -41.1% to -1.0%; $P = .04$), year 4 (-20.2%; 95% CI, -33.6% to -4.0%; $P = .02$), year 5 (-33.7%; 95% CI, -50.9% to -10.4%; $P = .008$), and year 6 (-33.3%; 95% CI, -44.7% to -19.6%; $P < .001$). In secondary analyses, the findings remained similar. **Conclusions and Relevance:** Medical cannabis laws are associated with significantly lower state-level opioid overdose mortality rates. Further investigation is required to determine how medical cannabis laws may interact with policies aimed at preventing opioid analgesic overdose.

Boehnke, K. F., Litinas, E., & Clauw, D. J. (2016). Medical Cannabis Use Is Associated with Decreased Opiate Medication Use in a Retrospective Cross-Sectional Survey of Patients with Chronic Pain. *The Journal of Pain*, 17(6), 739-744. doi:10.1016/j.jpain.2016.03.002.

Abstract: Opioids are commonly used to treat patients with chronic pain (CP), though there is little evidence that they are effective for long term CP treatment. Previous studies reported strong associations between passage of medical cannabis laws and decrease in opioid overdose statewide. Our aim was to examine whether using medical cannabis for CP changed individual patterns of opioid use. Using an online questionnaire, we conducted a cross-sectional retrospective survey of 244 medical cannabis patients with CP who patronized a medical cannabis dispensary in Michigan between November 2013 and February 2015. Data collected included demographic information, changes in opioid use, quality of life, medication classes used, and medication side effects before and after initiation of cannabis usage. Among study participants, medical cannabis use was associated with a 64% decrease in opioid use ($n = 118$), decreased number and side effects of medications, and an improved quality of life (45%). This study suggests that many CP patients are essentially substituting medical cannabis for opioids and other medications for CP treatment, and finding the benefit and side effect profile of cannabis to be greater than these other classes of medications. More research is needed to validate this finding. **Perspective:** This article suggests that using medical cannabis for CP treatment may benefit some CP patients. The reported improvement in quality of life, better side effect profile, and decreased opioid use should be confirmed by rigorous, longitudinal studies that also assess how CP patients use medical cannabis for pain management.

Bonar, E. E., Goldstick, J. E., Collins, R. L., Cranford, J. A., Cunningham, R. M., Chermack, S. T., . . . Walton, M. A. (2017). Daily associations between cannabis motives and consumption in emerging adults. *Drug and Alcohol Dependence*, 178, 136-142. doi:10. 1016/j.drugalcdep.2017.05.006.

Background: Increasing rates of cannabis use among emerging adults is a growing public health problem. Intensive longitudinal data can provide information on proximal motives for cannabis use, which can inform

interventions to reduce use among emerging adults. **Method:** As part of a larger longitudinal study, patients aged 18-25 years (N=95) recruited from an urban Emergency Department completed daily text message assessments of risk behaviors for 28 days, including daily cannabis quantity and motives. Using a mixed effects linear regression model, we examined the relationships between daily quantity of cannabis consumed and motives (i.e., enhancement, social, conformity, coping, and expansion). **Results:** Participants were, on average, 22.0 years old (SD=2.2); 48.4% were male, 45.3% were African American, and 56.8% received public assistance. Results from the multi-level analysis (clustering day within individual), controlling for gender, race, and receipt of public assistance, indicated daily use of cannabis for enhancement ($\beta=0.27$), coping ($\beta=0.15$), and/or social motives ($\beta=0.34$) was significantly associated with higher quantities of daily cannabis use; whereas expansion and conformity motives were not. **Conclusions:** Daily data show that emerging adults who use cannabis for enhancement, social, and coping motives reported using greater quantities of cannabis. Future research should examine more comprehensive cannabis motives (e.g., boredom, social anxiety, sleep) and test tailored interventions focusing on alternative cognitive/behavioral strategies to address cannabis motives.

Bradford, A. C., & Bradford, W. D. (2016). Medical Marijuana Laws Reduce Prescription Medication Use in Medicare Part D. *Health Affairs*, 35(7), 1230-1236. doi:10.1377/ hlthaff.2015.1661.

Abstract: Legalization of medical marijuana has been one of the most controversial areas of state policy change over the past twenty years. However, little is known about whether medical marijuana is being used clinically to any significant degree. Using data on all prescriptions filled by Medicare Part D enrollees from 2010 to 2013, we found that the use of prescription drugs for which marijuana could serve as a clinical alternative fell significantly, once a medical marijuana law was implemented. National overall reductions in Medicare program and enrollee spending when states implemented medical marijuana laws were estimated to be \$165.2 million per year in 2013. The availability of medical marijuana has a significant effect on prescribing patterns and spending in Medicare Part D.

Bradford, A. C., Bradford, W. D., Abraham, A., & Adams, G. B. (2018). Association Between US State Medical Cannabis Laws and Opioid Prescribing in the Medicare Part D Population. *JAMA Internal Medicine*. doi:10.1001/jamainternmed.2018.0266.

Importance: Opioid-related mortality increased by 15.6% from 2014 to 2015 and increased almost 320% between 2000 and 2015. Recent research finds that the use of all pain medications (opioid and nonopioid collectively) decreases in Medicare Part D and Medicaid populations when states approve medical cannabis laws (MCLs). The association between MCLs and opioid prescriptions is not well understood. **Objective:** To examine the association between prescribing patterns for opioids in Medicare Part D and the implementation of state MCLs. **Design, Setting, and Participants:** Longitudinal analysis of the daily doses of opioids filled in Medicare Part D for all opioids as a group and for categories of opioids by state and state-level MCLs from 2010 through 2015. Separate models were estimated first for whether the state had implemented any MCL and second for whether a state had implemented either a dispensary-based or a home cultivation only-based MCL. **Main Outcomes and Measures:** The primary outcome measure was the total number of daily opioid doses prescribed (in millions) in each US state for all opioids. The secondary analysis examined the association between MCLs separately by opioid class. **Results:** From 2010 to 2015 there were 23.08 million daily doses of any opioid dispensed per year in the average state under Medicare Part D. Multiple regression analysis results found that patients filled fewer daily doses of any opioid in states with an MCL. The associations between MCLs and any opioid prescribing were statistically significant when we took the type of MCL into account: states with active dispensaries saw 3.742 million fewer daily doses filled (95% CI, -6.289 to -1.194); states with home cultivation only MCLs saw 1.792 million fewer filled daily doses (95% CI, -3.532 to -0.052). Results varied by type of opioid, with statistically significant estimated negative associations observed for hydrocodone and morphine.

Hydrocodone use decreased by 2.320 million daily doses (or 17.4%) filled with dispensary-based MCLs (95% CI, -3.782 to -0.859; $P = .002$) and decreased by 1.256 million daily doses (or 9.4%) filled with home-cultivation-only-based MCLs (95% CI, -2.319 to -0.193; $P = .02$). Morphine use decreased by 0.361 million daily doses (or 20.7%) filled with dispensary-based MCLs (95% CI, -0.718 to -0.005; $P = .047$). **Conclusions and Relevance:** Medical cannabis laws are associated with significant reductions in opioid prescribing in the Medicare Part D population. This finding was particularly strong in states that permit dispensaries, and for reductions in hydrocodone and morphine prescriptions.

Chen, H., & Searles, J. S. (2017). Health Considerations in Regulating Marijuana in Vermont. *Preventive Medicine*, 104, 7-9. doi:10.1016/j.ypmed.2017.06.004.

Abstract: This article delineates the current efforts of the Vermont Department of Health (VDH) to address the potential health impact of legalization and regulation of recreational marijuana for use by adults at least 21 years of age. To this end, VDH and key stakeholders developed and published a Health Impact Assessment with specific recommendations should legislation that legalized and regulated marijuana be passed into law. Although the legalization legislation failed in 2016 and was vetoed by the Governor in 2017, it is unclear what will happen in the future.

Gunn, J. K., Rosales, C. B., Center, K. E., Nuñez, A., Gibson, S. J., Christ, C., & Ehiri, J. E. (2016). Prenatal Exposure to Cannabis and Maternal and Child Health Outcomes: A Systematic Review and Meta-Analysis. *BMJ Open*, 6(4). doi:10.1136/bmjopen-2015-009986.

Objective: To assess the effects of use of cannabis during pregnancy on maternal and fetal outcomes. **Data Sources:** 7 electronic databases were searched from inception to 1 April 2014. Studies that investigated the effects of use of cannabis during pregnancy on maternal and fetal outcomes were included. **Study Selection:** Case-control studies, cross-sectional and cohort studies were included. **Data Extraction and Synthesis:** Data synthesis was undertaken via systematic review and meta-analysis of available evidence. All review stages were conducted independently by 2 reviewers. **Main Outcomes and Measures:** Maternal, fetal and neonatal outcomes up to 6 weeks postpartum after exposure to cannabis. Meta-analyses were conducted on variables that had 3 or more studies that measured an outcome in a consistent manner. Outcomes for which meta-analyses were conducted included: anaemia, birth weight, low birth weight, neonatal length, placement in the neonatal intensive care unit, gestational age, head circumference and preterm birth. **Results:** 24 studies were included in the review. Results of the meta-analysis demonstrated that women who used cannabis during pregnancy had an increase in the odds of anaemia (pooled OR (pOR)=1.36: 95% CI 1.10 to 1.69) compared with women who did not use cannabis during pregnancy. Infants exposed to cannabis in utero had a decrease in birth weight (low birth weight pOR=1.77: 95% CI 1.04 to 3.01; pooled mean difference (pMD) for birth weight=109.42 g: 38.72 to 180.12) compared with infants whose mothers did not use cannabis during pregnancy. Infants exposed to cannabis in utero were also more likely to need placement in the neonatal intensive care unit compared with infants whose mothers did not use cannabis during pregnancy (pOR=2.02: 1.27 to 3.21). **Conclusions:** Use of cannabis during pregnancy may increase adverse outcomes for women and their neonates. As use of cannabis gains social acceptance, pregnant women and their medical providers could benefit from health education on potential adverse effects of use of cannabis during pregnancy.

Hall, W. (2017). Alcohol and Cannabis: Comparing Their Adverse Health Effects and Regulatory Regimes. *International Journal of Drug Policy*, 42, 57-62. doi:10.1016/j.drugpo.2016.10.021.

Abstract: The claim that the adverse health effects of cannabis are much less serious than those of alcohol has been central to the case for cannabis legalisation. Regulators in US states that have legalised cannabis have

adopted regulatory models based on alcohol. This paper critically examines the claim about adverse health effects and the wisdom of regulating cannabis like alcohol. First, it compares what we know about the adverse health effects of alcohol and cannabis. Second, it discusses the uncertainties about the long term health effects of sustained daily cannabis use. Third, it speculates about how the adverse health effects of cannabis may change after legalisation. Fourth, it questions the assumption that alcohol provides the best regulatory model for a legal cannabis market. Fifth, it outlines the major challenges in regulating cannabis under the liberal alcohol-like regulatory regimes now being introduced.

Hall, W., & Weier, M. (2015). Assessing the public health impacts of legalizing recreational cannabis use in the USA. *Clinical Pharmacology & Therapeutics*, 97(6), 607-615. doi:10.1002/cpt.110.

A major challenge in assessing the public health impact of legalizing cannabis use in Colorado and Washington State is the absence of any experience with legal cannabis markets. The Netherlands created a *de facto* legalized cannabis market for recreational use, but policy analysts disagree about how it has affected rates of cannabis use. Some US states have created *de facto* legal supply of cannabis for medical use. So far this policy does not appear to have increased cannabis use or cannabis-related harm. Given experience with more liberal alcohol policies, the legalization of recreational cannabis use is likely to increase use among current users. It is also likely that legalization will increase the number of new users among young adults but it remains uncertain how many may be recruited, within what time frame, among which groups within the population, and how many of these new users will become regular users.

Hasin, D. S., Saha, T. D., Kerridge, B. T., Goldstein, R. B., Chou, S. P., Zhang, H., . . . Grant, B. F. (2015). Prevalence of Marijuana Use Disorders in the United States Between 2001-2002 and 2012-2013. *JAMA Psychiatry*, 72(12), 1235. doi:10.1001/jamapsychiatry.2015.1858.

Importance: Laws and attitudes toward marijuana in the United States are becoming more permissive but little is known about whether the prevalence rates of marijuana use and marijuana use disorders have changed in the 21st century. **Objective:** To present nationally representative information on the past-year prevalence rates of marijuana use, marijuana use disorder, and marijuana use disorder among marijuana users in the US adult general population and whether this has changed between 2001-2002 and 2012-2013. **Design, Setting, and Participants:** Face-to-face interviews conducted in surveys of 2 nationally representative samples of US adults: the National Epidemiologic Survey on Alcohol and Related Conditions (data collected April 2001-April 2002; N = 43,093) and the National Epidemiologic Survey on Alcohol and Related Conditions-III (data collected April 2012-June 2013; N = 36,309). Data were analyzed March through May 2015. **Main Outcomes and Measures:** Past-year marijuana use and DSM-IV marijuana use disorder (abuse or dependence). **Results:** The past-year prevalence of marijuana use was 4.1% (SE, 0.15) in 2001-2002 and 9.5% (SE, 0.27) in 2012-2013, a significant increase ($P < .05$). Significant increases were also found across demographic subgroups (sex, age, race/ethnicity, education, marital status, income, urban/rural, and region). The past-year prevalence of DSM-IV marijuana use disorder was 1.5% (0.08) in 2001-2002 and 2.9% (SE, 0.13) in 2012-2013 ($P < .05$). With few exceptions, increases in the prevalence of marijuana use disorder between 2001-2002 and 2012-2013 were also statistically significant ($P < .05$) across demographic subgroups. However, the prevalence of marijuana use disorder among marijuana users decreased significantly from 2001-2002 (35.6%; SE, 1.37) to 2012-2013 (30.6%; SE, 1.04). **Conclusions:** The prevalence of marijuana use more than doubled between 2001-2002 and 2012-2013, and there was a large increase in marijuana use disorders during that time. While not all marijuana users experience problems, nearly 3 of 10 marijuana users manifested a marijuana use disorder in 2012-2013. Because the risk for marijuana use disorder did not increase among users, the increase in prevalence of marijuana use disorder is owing to an increase in prevalence of users in the US adult population. Given changing laws and attitudes toward marijuana, a balanced presentation of the likelihood of adverse consequences of marijuana use to policy makers, professionals, and the public is needed.

Lucas, P., Walsh, Z., Crosby, K., Callaway, R., Belle-Isle, L., Kay, R., . . . Holtzman, S. (2015). Substituting Cannabis for Prescription Drugs, Alcohol and Other Substances Among Medical Cannabis Patients: The Impact of Contextual Factors. *Drug and Alcohol Review*, 35(3), 326-333. doi:10.1111/dar.12323.

Introduction: Recent years have witnessed increased attention to how cannabis use impacts the use of other psychoactive substances. The present study examines the use of cannabis as a substitute for alcohol, illicit substances and prescription drugs among 473 adults who use cannabis for therapeutic purposes. **Design and Methods:** The Cannabis Access for Medical Purposes Survey is a 414-question cross-sectional survey that was available to Canadian medical cannabis patients online and by hard copy in 2011 and 2012 to gather information on patient demographics, medical conditions and symptoms, patterns of medical cannabis use, cannabis substitution and barriers to access to medical cannabis. **Results:** Substituting cannabis for one or more of alcohol, illicit drugs or prescription drugs was reported by 87% (n = 410) of respondents, with 80.3% reporting substitution for prescription drugs, 51.7% for alcohol, and 32.6% for illicit substances. Respondents who reported substituting cannabis for prescription drugs were more likely to report difficulty affording sufficient quantities of cannabis, and patients under 40 years of age were more likely to substitute cannabis for all three classes of substance than older patients. **Conclusions:** The finding that cannabis was substituted for all three classes of substances suggests that the medical use of cannabis may play a harm reduction role in the context of use of these substances, and may have implications for abstinence-based substance use treatment approaches. Further research should seek to differentiate between biomedical substitution for prescription pharmaceuticals and psychoactive drug substitution, and to elucidate the mechanisms behind both.

Mark, K., & Terplan, M. (2017). Cannabis and pregnancy: Maternal Child Health Implications During a Period of Drug Policy Liberalization. *Preventive Medicine*, 104, 46-49. doi:10.1016/j.ypmed.2017.05.012.

Abstract: Cannabis use is common and increasing among women in the United States. State policies are changing with a movement towards decriminalization and legalization. We explore the implications of cannabis liberalization for maternal and child health. Most women who use cannabis quit or cut back during pregnancy. Although women are concerned about the possible health effects of cannabis, providers do a poor job of counseling. There is a theoretical potential for cannabis to interfere with neurodevelopment, however human data have not identified any long-term or long lasting meaningful differences between children exposed in utero to cannabis and those not. Scientifically accurate dissemination of cannabis outcomes data is necessary. Risks should be neither overstated nor minimized, and the legal status of a substance should not be equated with safety. Decreasing or stopping use of all recreational drugs should be encouraged during pregnancy. Providers must recognize that even in environments where cannabis is legal, pregnant women may end up involved with Child Protective Services. In states where substance use is considered child abuse this may be especially catastrophic. Above all, care for pregnant women who use cannabis should be non-punitive and grounded in respect for patient autonomy.

Morris, M. A., Jacobson, S. R., Kinney, G. L., Tashkin, D. P., Woodruff, P. G., Hoffman, E. A., . . . Bowler, R. P. (2018). Original Research Marijuana Use Associations with Pulmonary Symptoms and Function in Tobacco Smokers Enrolled in The Subpopulations and Intermediate Outcome Measures in COPD Study (SPIROMICS). *Chronic Obstructive Pulmonary Diseases: Journal of the COPD Foundation*, 5(1), 46-56. doi:10.15326/jcopdf.5.1.2017.0141.

Background: Marijuana is often smoked via a filterless cigarette and contains similar chemical makeup as smoked tobacco. There are few publications describing usage patterns and respiratory risks in older adults or in those with chronic obstructive pulmonary disease (COPD). **Methods:** A cross-sectional analysis of current and

former tobacco smokers from the Subpopulations and Intermediate Outcome Measures in COPD Study (SPIROMICS) study assessed associations between marijuana use and pulmonary outcomes. Marijuana use was defined as never, former (use over 30 days ago), or current (use within 30 days). Respiratory health was assessed using quantitative high-resolution computed tomography (HRCT) scans, pulmonary function tests and questionnaire responses about respiratory symptoms. **Results:** Of the total 2304 participants, 1130 (49%) never, 982 (43%) former, and 192 (8%) current marijuana users were included. Neither current nor former marijuana use was associated with increased odds of wheeze (odds ratio [OR] 0.87, OR 0.97), cough (OR 1.22; OR 0.93) or chronic bronchitis (OR 0.87; OR 1.00) when compared to never users. Current and former marijuana users had lower quantitative emphysema ($P=0.004$, $P=0.03$), higher percent predicted forced expiratory volume in 1 second (FEV₁%) ($P<0.001$, $P<0.001$), and percent predicted forced vital capacity (FVC%) ($p<0.001$, $P<0.001$). Current marijuana users exhibited higher total tissue volume ($P=0.003$) while former users had higher air trapping ($P<0.001$) when compared to never marijuana users. **Conclusions:** Marijuana use was found to have little to no association with poor pulmonary health in older current and former tobacco smokers after adjusting for covariates. Higher forced expiratory volume in 1 second (FEV₁) and forced vital capacity (FVC) was observed among current marijuana users. However, higher joint years was associated with more chronic bronchitis symptoms (e.g., wheeze), and this study cannot determine if long-term heavy marijuana smoking in the absence of tobacco smoking is associated with lung symptoms, airflow obstruction, or emphysema, particularly in those who have never smoked tobacco cigarettes.

Pletcher, M. J., Vittinghoff, E., Kalhan, R., Richman, J., Safford, M., Sidney, S., . . . Kertesz, S. (2012). Association Between Marijuana Exposure and Pulmonary Function Over 20 Years. *Jama*, 307(2), 173. doi:10.1001/jama.2011.1961.

Abstract: Marijuana smoke contains many of the same constituents as tobacco smoke, but whether it has similar adverse effects on pulmonary function is unclear. **Objective:** To analyze associations between marijuana (both current and lifetime exposure) and pulmonary function. **Design:** The Coronary Artery Risk Development in Young Adults (CARDIA) study, a longitudinal study collecting repeated measurements of pulmonary function and smoking over 20 years (March 26, 1985-August 19, 2006) in a cohort of 5115 men and women in 4 US cities. Mixed linear modeling was used to account for individual age-based trajectories of pulmonary function and other covariates including tobacco use, which was analyzed in parallel as a positive control. Lifetime exposure to marijuana joints was expressed in joint-years, with 1 joint-year of exposure equivalent to smoking 365 joints or filled pipe bowls. **Main Outcome:** Forced expiratory volume in the first second of expiration (FEV(1)) and forced vital capacity (FVC). **Results:** Marijuana exposure was nearly as common as tobacco exposure but was mostly light (median, 2-3 episodes per month). Tobacco exposure, both current and lifetime, was linearly associated with lower FEV(1) and FVC. In contrast, the association between marijuana exposure and pulmonary function was nonlinear ($P < .001$): at low levels of exposure, FEV(1) increased by 13 mL/joint-year (95% CI, 6.4 to 20; $P < .001$) and FVC by 20 mL/joint-year (95% CI, 12 to 27; $P < .001$), but at higher levels of exposure, these associations leveled or even reversed. The slope for FEV(1) was -2.2 mL/joint-year (95% CI, -4.6 to 0.3; $P = .08$) at more than 10 joint-years and -3.2 mL per marijuana smoking episode/mo (95% CI, -5.8 to -0.6; $P = .02$) at more than 20 episodes/mo. With very heavy marijuana use, the net association with FEV(1) was not significantly different from baseline, and the net association with FVC remained significantly greater than baseline (eg, at 20 joint-years, 76 mL [95% CI, 34 to 117]; $P < .001$). **Conclusion:** Occasional and low cumulative marijuana use was not associated with adverse effects on pulmonary function.

Powell, D., Pacula, R. L., & Jacobson, M. (2018). Do Medical Marijuana Laws Reduce Addictions and Deaths Related to Pain Killers? *Journal of Health Economics*, 58, 29-42. doi:10.1016/j.jhealeco.2017.12.007.

Abstract: Recent work finds that medical marijuana laws reduce the daily doses filled for opioid analgesics among Medicare Part-D and Medicaid enrollees, as well as population-wide opioid overdose deaths. We replicate the result for opioid overdose deaths and explore the potential mechanism. The key feature of a medical marijuana law that facilitates a reduction in overdose death rates is a relatively liberal allowance for dispensaries. As states have become more stringent in their regulation of dispensaries, the protective value generally has fallen. These findings suggest that broader access to medical marijuana facilitates substitution of marijuana for powerful and addictive opioids.

Russell, C., Rueda, S., Room, R., Tyndall, M., & Fischer, B. (2018). Routes of Administration for Cannabis Use – Basic Prevalence and Related Health Outcomes: A Scoping Review and Synthesis. *International Journal of Drug Policy*, 52, 87-96. doi:10.1016/j.drugpo.2017.11.008.

Background: Cannabis use is common, and associated with adverse health outcomes. 'Routes of administration' (ROAs) for cannabis use have increasingly diversified, in part influenced by developments towards legalization. This paper sought to review data on prevalence and health outcomes associated with different ROAs. **Methods:** This scoping review followed a structured approach. Electronic searches for English-language peer-reviewed publications were conducted in primary databases (i.e., MEDLINE, EMBASE, PsycINFO, Google Scholar) based on pertinent keywords. Studies were included if they contained information on prevalence and/or health outcomes related to cannabis use ROAs. Relevant data were screened, extracted and narratively summarized under distinct ROA categories. **Results:** Overall, there is a paucity of rigorous and high-quality data on health outcomes from cannabis ROAs, especially in direct and quantifiable comparison. Most data exist on smoking combusted cannabis, which is associated with various adverse respiratory system outcomes (e.g., bronchitis, lung function). Vaporizing natural cannabis and ingesting edibles appear to reduce respiratory system problems, but may come with other risks (e.g., delayed impairment, use 'normalization'). Vaporizing cannabis concentrates can result in distinct acute risks (e.g., excessive impairment, injuries). Other ROAs are uncommon and under-researched. **Conclusions:** ROAs appear to distinctly influence health outcomes from cannabis use, yet systematic data for comparative assessments are largely lacking; these evidence gaps require filling. Especially in emerging legalization regimes, ROAs should be subject to evidence-based regulation towards improved public health outcomes. Concretely, vaporizers and edibles may offer potential for reduced health risks, especially concerning respiratory problems. Adequate cannabis product regulation (e.g., purity, labeling, THC-restrictions) is required to complement ROA-based effects.

Rotermann, M., & Macdonald, R. (2018). Analysis of Trends in the Prevalence of Cannabis Use in Canada, 1985 to 2015. *Health Reports*, 29(2), 10-20.

Background: The Canadian federal government has committed to legalize, regulate, and restrict non-medical cannabis use by adults in 2018. To prepare for monitoring the health, social and economic impacts of this policy change, a greater understanding of the long-term trends in the prevalence of cannabis use in Canada is needed. **Methods:** Nine national surveys of the household population collected information about cannabis use during the period from 1985 through 2015. These surveys are examined for comparability. The data are used to estimate past-year (current) cannabis use (total, and by sex and age). Based on the most comparable data, trends in use from 2004 through 2015 are estimated. **Results:** From 1985 through 2015, past-year cannabis use increased overall. Analysis of comparable data from the Canadian Tobacco Use Monitoring Survey and the Canadian Tobacco, Alcohol and Drugs Survey for the 2004-to-2015 period suggests that use was stable among 15- to 17-year-old males, decreased among 15- to 17-year-old females and among 18- to 24-year-olds (both sexes), and increased among people aged 25 or older. **Discussion:** According to data from national population surveys, since 2004, cannabis use was stable or decreased among youth, and rose among adults. Results highlight the importance of consistent monitoring of use in the pre-and post-legalization periods.

Sohler, N. L., Starrels, J. L., Khalid, L., Bachhuber, M. A., Arnsten, J. H., Nahvi, S., . . . Cunningham, C. O. (2018). Cannabis Use is Associated with Lower Odds of Prescription Opioid Analgesic Use Among HIV-Infected Individuals with Chronic Pain. *Substance Use & Misuse*, 1-6. doi:10.1080/10826084.2017.1416408.

Background: Chronic pain is common in the United States and prescribed opioid analgesics use for noncancer pain has increased dramatically in the past two decades, possibly accounting for the current opioid addiction epidemic. Co-morbid drug use in those prescribed opioid analgesics is common, but there are few data on polysubstance use patterns. **Objective:** We explored patterns of use of cigarette, alcohol, and illicit drugs in HIV-infected people with chronic pain who were prescribed opioid analgesics. **Methods:** We conducted a secondary data analysis of screening interviews conducted as part of a parent randomized trial of financial incentives to improve HIV outcomes among drug users. In a convenience sample of people with HIV and chronic pain, we collected self-report data on demographic characteristics; pain; patterns of opioid analgesic use (both prescribed and illicit); cigarette, alcohol, and illicit drug use (including cannabis, heroin, and cocaine) within the past 30 days; and current treatment for drug use and HIV. **Results:** Almost half of the sample of people with HIV and chronic pain reported current prescribed opioid analgesic use (N = 372, 47.1%). Illicit drug use was common (N = 505, 63.9%), and cannabis was the most commonly used illicit substance (N = 311, 39.4%). In multivariate analyses, only cannabis use was significantly associated with lower odds of prescribed opioid analgesic use (adjusted odds ratio = 0.57; 95% confidence interval: 0.38-0.87). **Conclusions/Importance:** Our data suggest that new medical cannabis legislation might reduce the need for opioid analgesics for pain management, which could help to address adverse events associated with opioid analgesic use.

Stogner, J. M., & Miller, B. L. (2015). Assessing the Dangers of "Dabbing": Mere Marijuana or Harmful New Trend? *Pediatrics*, 136(1), 1-3. doi:10.1542/peds.2015-0454.

The practice now known as "dabbing" appears to be quickly proliferating as a fashionable way to use marijuana in the United States. Dabbing is the inhalation of a concentrated tetrahydrocannabinol (THC) product created through butane extraction. The use of butane hash oil (BHO) products and the modification of cannabis more generally are not new phenomena, but dabbing has recently moved from relative obscurity to the headlines, leaving cannabis aficionados, adolescents, and parents curious about its effects. Physicians and other health care professionals need to be prepared for discussions about the effects of dabbing to minimize potential harms, particularly because recent marijuana policy changes likely have facilitated youth access to "dabs".

Tarter, R. (2006). Predictors of Marijuana Use in Adolescents Before and After Licit Drug Use: Examination of the Gateway Hypothesis. *American Journal of Psychiatry*, 163(12), 2134. doi:10.1176/appi.ajp.163.12.2134.

Objective: The authors investigated whether the transition from licit drug use to marijuana use is determined by particular risk factors, as specified by the gateway hypothesis. They also evaluated the accuracy of the "gateway sequence" (illicit drug use following licit drugs) for predicting a diagnosis of substance use disorder. **Method:** Boys who consumed licit drugs only (N=99), boys who consumed licit drugs and then transitioned to marijuana use (gateway sequence) (N=97), and boys who used marijuana before using licit substances (alternative sequence) (N=28) were prospectively studied from ages 10-12 years through 22 years to determine whether specific factors were associated with each drug use pattern. The groups were compared on 35 variables measuring psychological, family, peer, school, and neighborhood characteristics. In addition, the utility of the gateway and alternative sequences in predicting substance use disorder was compared to assess their clinical informativeness. **Results:** Twenty-eight (22.4%) of the participants who used marijuana did not exhibit the gateway sequence, thereby demonstrating that this pattern is not invariant in drug-using youths. Among youths who did exhibit the gateway pattern, only delinquency was more strongly related to marijuana use than licit drug use. Specific risk factors associated with transition from licit to illicit drugs were not revealed. The

alternative sequence had the same accuracy for predicting substance use disorder as the gateway sequence. **Conclusions:** Proneness to deviancy and drug availability in the neighborhood promote marijuana use. These findings support the common liability model of substance use behavior and substance use disorder.

Volkow, N. D., Baler, R. D., Compton, W. M., & Weiss, S. R. (2014). Adverse Health Effects of Marijuana Use. *New England Journal of Medicine*, 370(23), 2219-2227. doi:10.1056/nejmra1402309.

In light of the rapidly shifting landscape regarding the legalization of marijuana for medical and recreational purposes, patients may be more likely to ask physicians about its potential adverse and beneficial effects on health. The popular notion seems to be that marijuana is a harmless pleasure, access to which should not be regulated or considered illegal. Currently, marijuana is the most commonly used “illicit” drug in the United States, with about 12% of people 12 years of age or older reporting use in the past year and particularly high rates of use among young people. The most common route of administration is inhalation. The greenish-gray shredded leaves and flowers of the *Cannabis sativa* plant are smoked (along with stems and seeds) in cigarettes, cigars, pipes, water pipes, or “blunts” (marijuana rolled in the tobacco-leaf wrapper from a cigar). Hashish is a related product created from the resin of marijuana flowers and is usually smoked (by itself or in a mixture with tobacco) but can be ingested orally. Marijuana can also be used to brew tea, and its oil-based extract can be mixed into food products.

Vyas, M. B., Lebaron, V. T., & Gilson, A. M. (2018). The Use of Cannabis in Response to the Opioid Crisis: A Review of the Literature. *Nursing Outlook*, 66(1), 56-65. doi:10.1016/j.outlook.2017.08.012.

Background: A staggering number of Americans are dying from overdoses attributed to prescription opioid medications (POMs). In response, states are creating policies related to POM harm reduction strategies, overdose prevention, and alternative therapies for pain management, such as cannabis (medical marijuana). However, little is known about how the use of cannabis for pain management may be associated with POM use. **Purpose:** The purpose of this article is to examine state medical cannabis (MC) use laws and policies and their potential association with POM use and related harms. **Methods:** A systematic literature review was conducted to explore United States policies related to MC use and the association with POM use and related harms. Medline, PubMed, CINAHL, and Cochrane databases were searched to identify peer-reviewed articles published between 2010 and 2017. Using the search criteria, 11,513 records were identified, with 789 abstracts reviewed, and then 134 full-text articles screened for eligibility. **Findings:** Of 134 articles, 10 articles met inclusion criteria. Four articles were cross-sectional online survey studies of MC substitution for POM, six were secondary data analyses exploring state-level POM overdose fatalities, hospitalizations related to MC or POM harms, opioid use disorder admissions, motor vehicle fatalities, and Medicare and Medicaid prescription cost analyses. The literature suggests MC laws could be associated with decreased POM use, fewer POM-related hospitalizations, lower rates of opioid overdose, and reduced national health care expenditures related to POM overdose and misuse. However, available literature on the topic is sparse and has notable limitations. **Conclusions:** Review of the current literature suggests states that implement MC policies could reduce POM-associated mortality, improve pain management, and significantly reduce health care costs. However, MC research is constrained by federal policy restrictions, and more research related to MC as a potential alternative to POM for pain management, MC harms, and its impact on POM-related harms and health care costs should be a priority of public health, medical, and nursing research.

Wang, G. S., Hall, K., Vigil, D., Banerji, S., Monte, A., & Vandyke, M. (2017). Marijuana and Acute Health Care Contacts in Colorado. *Preventive Medicine*, 104, 24-30. doi:10.1016/j.ypmed.2017.03.022.

Abstract: Over 22 million Americans are current users of marijuana; half of US states allow medical marijuana, and several allow recreational marijuana. The objective of this study was to evaluate the impact marijuana has on hospitalizations, emergency department (ED) visits, and regional poison center (RPC) calls in Colorado, a medical and recreational marijuana state. This is a retrospective review using Colorado Hospital Association hospitalizations and ED visits with marijuana-related billing codes, and RPC marijuana exposure calls. Legalization of marijuana in Colorado has been associated with an increase in hospitalizations, ED visits, and RPC calls linked with marijuana exposure. From 2000 to 2015, hospitalization rates with marijuana-related billing codes increased from 274 to 593 per 100,000 hospitalizations in 2015. Overall, the prevalence of mental illness among ED visits with marijuana-related codes was five-fold higher (5.07, 95% CI: 5.0, 5.1) than the prevalence of mental illness without marijuana-related codes. RPC calls remained constant from 2000 through 2009. However, in 2010, after local medical marijuana policy liberalization, the number of marijuana exposure calls significantly increased from 42 to 93; in 2014, after recreational legalization, calls significantly increased by 79.7%, from 123 to 221 ($p < 0.0001$). The age group <17 years old also had an increase in calls after 2014. As more states legalize marijuana, it is important to address public education and youth prevention, and understand the impact on mental health disorders. Improvements in data collection and surveillance methods are needed to more accurately evaluate the public health impact of marijuana legalization.

Wang, G. S., Roosevelt, G., Lait, M. L., Martinez, E. M., Bucher-Bartelson, B., Bronstein, A. C., & Heard, K. (2014). Association of Unintentional Pediatric Exposures with Decriminalization of Marijuana in the United States. *Annals of Emergency Medicine*, 63(6), 684-689. doi:10.1016/j.annemergmed.2014.01.017.

Objective: We compare state trends in unintentional pediatric marijuana exposures, as measured by call volume to US poison centers, by state marijuana legislation status. **Methods:** A retrospective review of the American Association of Poison Control Centers National Poison Data System was performed from January 1, 2005, to December 31, 2011. States were classified as nonlegal if they have not passed legislation, transitional if they enacted legislation between 2005 and 2011, and decriminalized if laws passed before 2005. Our hypotheses were that decriminalized and transitional states would experience a significant increase in call volume, with more symptomatic exposures and more health care admissions than nonlegal states. **Results:** There were 985 unintentional marijuana exposures reported from 2005 through 2011 in children aged 9 years and younger: 496 in nonlegal states, 93 in transitional states, and 396 in decriminalized states. There was a slight male predominance, and the median age ranged from 1.5 to 2.0 years. Clinical effects varied, with neurologic effects the most frequent. More exposures in decriminalized states required health care evaluation and had moderate to major clinical effects and critical care admissions compared with exposures from nonlegal states. The call rate in nonlegal states to poison centers did not change from 2005 to 2011. The call rate in decriminalized states increased by 30.3% calls per year, and transitional states had a trend toward an increase of 11.5% per year. **Conclusion:** Although the number of pediatric exposures to marijuana reported to the National Poison Data System was low, the rate of exposure increased from 2005 to 2011 in states that had passed marijuana legislation.

Wen, H., & Hockenberry, J. M. (2018). Association of Medical and Adult-Use Marijuana Laws with Opioid Prescribing for Medicaid Enrollees. *JAMA Internal Medicine*. doi:10.1001/jamainternmed.2018.1007.

Importance: Overprescribing of opioids is considered a major driving force behind the opioid epidemic in the United States. Marijuana is one of the potential nonopioid alternatives that can relieve pain at a relatively lower risk of addiction and virtually no risk of overdose. Marijuana liberalization, including medical and adult-use marijuana laws, has made marijuana available to more Americans. **Objective:** To examine the association of state implementation of medical and adult-use marijuana laws with opioid prescribing rates and spending among Medicaid enrollees. **Design, Setting, and Participants:** This cross-sectional study used a quasi-

experimental difference-in-differences design comparing opioid prescribing trends between states that started to implement medical and adult-use marijuana laws between 2011 and 2016 and the remaining states. This population-based study across the United States included all Medicaid fee-for-service and managed care enrollees, a high-risk population for chronic pain, opioid use disorder, and opioid overdose. **Exposures:** State implementation of medical and adult-use marijuana laws from 2011 to 2016. **Main Outcomes and Measures:** Opioid prescribing rate, measured as the number of opioid prescriptions covered by Medicaid on a quarterly, per-1000-Medicaid-enrollee basis. **Results:** State implementation of medical marijuana laws was associated with a 5.88% lower rate of opioid prescribing (95% CI, -11.55% to approximately -0.21%). Moreover, the implementation of adult-use marijuana laws, which all occurred in states with existing medical marijuana laws, was associated with a 6.38% lower rate of opioid prescribing (95% CI, -12.20% to approximately -0.56%). **Conclusions and Relevance:** The potential of marijuana liberalization to reduce the use and consequences of prescription opioids among Medicaid enrollees deserves consideration during the policy discussions about marijuana reform and the opioid epidemic.

Zhu, H., & Wu, L. (2017). Sex Differences in Cannabis Use Disorder Diagnosis Involved Hospitalizations in the United States. *Journal of Addiction Medicine, 11*(5), 357-367. doi:10.1097/adm.0000000000000330.

Objectives: The study examined sex differences in trend and clinical characteristics of cannabis use disorder (CUD) diagnosis involved hospitalizations among adult patients. **Methods:** We analyzed hospitalization data from the 2007-2011 Nationwide Inpatient Samples for patients aged 18-64 years (N = 15,114,930). Descriptive statistics were used to characterize demographic variables and to compare the proportions of CUD diagnosis and comorbid patterns between male and female hospitalizations. Logistic regressions were performed to examine the association of sex and other demographic variables with CUD diagnosis. **Results:** During the study period, 3.3% of male and 1.5% of female hospitalizations had any-listed CUD diagnoses, and both sexes presented an upward trend in the number, rate, and proportion of CUD diagnosis. Among hospitalizations for patients aged 18-25 years, about 1 in 10 males and 1 in 20 females included a CUD diagnosis, and this proportion decreased with age strata. Mental disorders accounted for the highest proportion of CUD involved inpatient hospitalizations, and female CUD involved hospitalizations included a higher proportion of mental disorders that required hospitalized care compared with male hospitalizations (41% vs 36%). In each sex group, younger age, black race, lower household income, large metropolitan residence, non-private insurance, substance use diagnosis, and mental disorders were associated with elevated odds of having CUD diagnosis. **Conclusion:** The large sample of clinical hospitalization data suggest an increased trend in CUD diagnosis and sex differences in several comorbidities with CUD-involved hospital admissions. Prevention and treatment for CUD should consider sex differences in clinical comorbidities.

Criminal Justice and Public Safety

Aston, E. R., Merrill, J. E., McCarthy, D. M., & Metrik, J. (2016). Risk Factors for Driving After and During Marijuana Use. *Journal of Studies on Alcohol and Drugs, 77*(2), 309-316. doi:10.15288/jsad.2016.77.309.

Objective: Use of marijuana before or while driving significantly contributes to driving impairment and elevated risk of motor vehicle accidents; however, this risk behavior is common among users. Little is known about the etiology of driving while under the influence of marijuana. **Method:** Guided by social learning theory, this study examined marijuana outcome expectancies and other driving-related cognitions as predictors of the frequency of driving after smoking marijuana (DASM) and smoking marijuana while driving (SMWD). A community sample of 151 (64% male) non-treatment-seeking frequent marijuana users completed questionnaires on variables of interest. **Results:** Perceived driving-related peer norms (i.e., perception that fewer friends disapprove of DASM

and SMWD and of riding with a driver under the influence of marijuana) were associated with lower frequency of both DASM and SMWD. Perceived dangerousness of DASM was also associated with decreased frequency of DASM. **Conclusions:** Our findings suggest a range of potentially important targets for interventions intended to reduce the likelihood and frequency of driving while under the influence of marijuana.

Aydelotte, J. D., Brown, L. H., Luftman, K. M., Mardock, A. L., Teixeira, P. G., Coopwood, B., & Brown, C. V. (2017). Crash Fatality Rates After Recreational Marijuana Legalization in Washington and Colorado. *American Journal of Public Health, 107*(8), 1329-1331. doi:10.2105/ajph.2017.303848.

Objectives: To evaluate motor vehicle crash fatality rates in the first 2 states with recreational marijuana legalization and compare them with motor vehicle crash fatality rates in similar states without recreational marijuana legalization. **Methods:** We used the US Fatality Analysis Reporting System to determine the annual numbers of motor vehicle crash fatalities between 2009 and 2015 in Washington, Colorado, and 8 control states. We compared year-over-year changes in motor vehicle crash fatality rates (per billion vehicle miles traveled) before and after recreational marijuana legalization with a difference-in-differences approach that controlled for underlying time trends and state-specific population, economic, and traffic characteristics. **RESULTS:** Pre-recreational marijuana legalization annual changes in motor vehicle crash fatality rates for Washington and Colorado were similar to those for the control states. Post-recreational marijuana legalization changes in motor vehicle crash fatality rates for Washington and Colorado also did not significantly differ from those for the control states (adjusted difference-in-differences coefficient = +0.2 fatalities/billion vehicle miles traveled; 95% confidence interval = -0.4, +0.9). **Conclusions:** Three years after recreational marijuana legalization, changes in motor vehicle crash fatality rates for Washington and Colorado were not statistically different from those in similar states without recreational marijuana legalization. Future studies over a longer time remain warranted.

Doucette, M. L., Frattaroli, S., & Vernick, J. S. (2017). Oral Fluid Testing for Marijuana Intoxication: Enhancing Objectivity for Roadside DUI Testing. *Injury Prevention, 24*(1), 78-80. doi:10.1136/injuryprev-2016-042264.

Abstract: Reducing marijuana-impaired driving is an important part of any strategy to prevent motor vehicle traffic injuries. In Colorado, the first of eight US states and the District of Columbia to legalise marijuana for recreational use, drivers with positive tests for the presence of marijuana accounted for a larger proportion of fatal MVCs after marijuana commercialisation. The use of blood tests to screen for marijuana intoxication, in Colorado and elsewhere in the USA, poses a number of challenges. Many high-income countries use oral fluid drug testing (OF) to provide roadside evidence of marijuana intoxication. A 2009 Belgium policy implementing OF roadside testing increased true positives and decreased false positives of suspected marijuana-related driving under the influence (DUI) arrests. US policy-makers should consider using roadside OF to increase objectivity and reliability for tests used in marijuana-related DUI arrests.

Freisthler, B., Gaidus, A., Tam, C., Ponicki, W. R., & Gruenewald, P. J. (2017). From Medical to Recreational Marijuana Sales: Marijuana Outlets and Crime in an Era of Changing Marijuana Legislation. *The Journal of Primary Prevention, 38*(3), 249-263. doi:10.1007/s10935-017-0472-9.

Abstract: A movement from medical to recreational marijuana use allows for a larger base of potential users who have easier access to marijuana, because they do not have to visit a physician before using marijuana. This study examines whether changes in the density of marijuana outlets were related to violent, property, and marijuana-specific crimes in Denver, CO during a time in which marijuana outlets began selling marijuana for recreational, and not just medical, use. We collected data on locations of crimes, marijuana outlets and covariates for 481 Census block groups over 34 months (N = 16,354 space-time units). A Bayesian Poisson space-time model assessed statistical relationships between independent measures and crime counts within "local"

Census block groups. We examined spatial "lag" effects to assess whether crimes in Census block groups adjacent to locations of outlets were also affected. Independent of the effects of covariates, densities of marijuana outlets were unrelated to property and violent crimes in local areas. However, the density of marijuana outlets in spatially adjacent areas was positively related to property crime in spatially adjacent areas over time. Further, the density of marijuana outlets in local and spatially adjacent blocks groups was related to higher rates of marijuana-specific crime. This study suggests that the effects of the availability of marijuana outlets on crime do not necessarily occur within the specific areas within which these outlets are located, but may occur in adjacent areas. Thus studies assessing the effects of these outlets in local areas alone may risk underestimating their true effects.

Jin, H., Williams, S. Z., Chihuri, S. T., Li, G., & Chen, Q. (2018). Validity of Oral Fluid Test for Delta-9-tetrahydrocannabinol in Drivers Using the 2013 National Roadside Survey Data. *Injury Epidemiology*, 5(1). doi:10.1186/s40621-018-0134-2.

Background: Driving under the influence of marijuana is a serious traffic safety concern in the United States. Delta 9-tetrahydrocannabinol (THC) is the main active compound in marijuana. Although blood THC testing is a more accurate measure of THC-induced impairment, measuring THC in oral fluid is a less intrusive and less costly method of testing. **Methods:** We examined whether the oral fluid THC test can be used as a valid alternative to the blood THC test using a sensitivity and specificity analysis and a logistic regression, and estimate the quantitative relationship between oral fluid THC concentration and blood THC concentration using a correlation analysis and a linear regression on the log-transformed THC concentrations. We used data from 4596 drivers who participated in the 2013 National Roadside Survey of Alcohol and Drug Use by Drivers and for whom THC testing results from both oral fluid and whole blood samples were available. **Results:** Overall, 8.9% and 9.4% of the participants tested positive for THC in oral fluid and whole blood samples, respectively. Using blood test as the reference criterion, oral fluid test for THC positivity showed a sensitivity of 79.4% (95% CI: 75.2%, 83.1%) and a specificity of 98.3% (95% CI: 97.9%, 98.7%). The log-transformed oral fluid THC concentration accounted for about 29% of the variation in the log-transformed blood THC concentration. That is, there is still 71% of the variation in the log-transformed blood THC concentration unexplained by the log-transformed oral fluid THC concentration. Back-transforming to the original scale, we estimated that each 10% increase in the oral fluid THC concentration was associated with a 2.4% (95% CI: 2.1%, 2.8%) increase in the blood THC concentration. **Conclusions:** The oral fluid test is a highly valid method for detecting the presence of THC in the blood but cannot be used to accurately measure the blood THC concentration.

Johnson, B. D., Ream, G. L., Dunlap, E., & Sifaneck, S. J. (2008). Civic Norms and Etiquettes Regarding Marijuana Use in Public Settings in New York City. *Substance Use & Misuse*, 43(7), 895-918. doi:10.1080/10826080701801477.

Abstract: This paper shows that active police enforcement of civic norms against marijuana smoking in public settings has influenced the locations where marijuana is smoked. It has subtly influenced the various marijuana etiquettes observed in both public and private settings. The ethnographic data reveal the importance of informal sanctions; most marijuana consumers report compliance with etiquettes mainly to avoid stigma from nonusing family, friends, and associates-they express limited concern about police and arrest.

Urfer, S., Morton, J., Beall, V., Feldmann, J., & Gunesch, J. (2014). Analysis of Δ9-tetrahydrocannabinol Driving Under the Influence of Drugs Cases in Colorado from January 2011 to February 2014. *Journal of Analytical Toxicology*, 38(8), 575-581. doi:10.1093/jat/bku089.

Abstract: Driving under the influence (DUI) and DUI drugs (DUID) law enforcement (LE) cases (n = 12,082) where whole blood samples were submitted to ChemaTox Laboratory, Inc. in Boulder, CO, for testing were examined. Of these 12,082 cases, there were 4,235 cannabinoid screens (CS) requested. Samples that yielded a positive CS (n = 2,621) were further analyzed. A total of 1,848 samples were confirmed for Δ^9 -tetrahydrocannabinol (THC) after a positive CS. Due to a decrease in the confirmation limit of detection (LOD) for THC from 2 to 1 ng/mL, samples that were confirmed for THC and quantitated below 2 ng/mL (n = 250) were considered negative. After this normalization, there were 1,598 samples that were confirmed positive for THC and included in the analysis. The percentage of LE cases with requests for CS for all years was 35%, increasing from 28% in 2011 to 37% in 2013. The positivity rate of CS overall was 62% (range: 59-68% by year) with no significant change over the time frame examined. The percentage of positive CS in which THC was confirmed positive at or above 2 ng/mL (n = 1,598) increased significantly from 28% in 2011 to 65% in 2013. The mean and median THC concentrations were 8.1 and 6.3 ng/mL, respectively (range: 2-192 ng/mL, n = 1,367). The data presented illustrate a statistically significant increase in CS that result in positive THC confirmations. Although the specific cause of this increase is not known at this time, possible ties to ongoing developments in Colorado's marijuana legislation merit further analysis.

Wong, K., Brady, J. E., & Li, G. (2014). Establishing Legal Limits for Driving Under the Influence of Marijuana. *Injury Epidemiology*, 1(1). doi:10.1186/s40621-014-0026-z.

Abstract: Marijuana has become the most commonly detected non-alcohol substance among drivers in the United States and Europe. Use of marijuana has been shown to impair driving performance and increase crash risk. Due to the lack of standardization in assessing marijuana-induced impairment and limitations of zero tolerance legislation, more jurisdictions are adopting per se laws by specifying a legal limit of Δ^9 -tetrahydrocannabinol (THC) at or above which drivers are prosecuted for driving under the influence of marijuana. This review examines major considerations when developing these threshold THC concentrations and specifics of legal THC limits for drivers adopted by different jurisdictions in the United States and other countries.

Economic

Aston, E. R., Metrik, J., & Mackillop, J. (2015). Further validation of a marijuana purchase task. *Drug and Alcohol Dependence*, 152, 32-38. doi:10.1016/j.drugalcdep. 2015.04.025.

Background: A valid measure of the relative economic value of marijuana is needed to characterize individual variation in the drug's reinforcing value and inform evolving national marijuana policy. Relative drug value (demand) can be measured via purchase tasks, and demand for alcohol and cigarettes has been associated with craving, dependence, and treatment response. This study examined marijuana demand with a marijuana purchase task (MPT). **Methods:** The 22-item self-report MPT was administered to 99 frequent marijuana users (37.4% female, 71.5% marijuana use days, 15.2% cannabis dependent). **Results:** Pearson correlations indicated a negative relationship between intensity (free consumption) and age of initiation of regular use ($r=-0.34$, $p<0.001$), and positive associations with use days ($r=0.26$, $p<0.05$) and subjective craving ($r=0.43$, $p<0.001$). Omax (maximum expenditure) was positively associated with use days ($r=0.29$, $p<0.01$) and subjective craving ($r=0.27$, $p<0.01$). Income was not associated with demand. An exponential demand model provided an excellent fit to the data across users ($R(2)=0.99$). Group comparisons based on presence or absence of DSM-IV cannabis dependence symptoms revealed that users with any dependence symptoms showed significantly higher intensity of demand and more inelastic demand, reflecting greater insensitivity to price increases. **Conclusions:** These results provide support for construct validity of the MPT, indicating its sensitivity to marijuana demand as

a function of increasing cost, and its ability to differentiate between users with and without dependence symptoms. The MPT may denote abuse liability and is a valuable addition to the behavioral economic literature. Potential applications to marijuana pricing and tax policy are discussed.

Azofeifa, A., Sherman, L. J., Mattson, M. E., & Pacula, R. L. (2018). Marijuana buyers in the United States, 2010–2014. *Drug and Alcohol Dependence*, 183, 34-42. doi:10.1016/j.drugalcdep.2017.10.019.

Background: Obtaining or purchasing marijuana in the U.S. can be done only in certain states via a lawful market for medical or non-medical (recreational) purposes, or via an unlawful market ("black market") by home cultivation and unlicensed vendors and individuals. Given the evolving U.S. state marijuana legislation landscape, the objective of this study is to describe individuals who report buying marijuana in the past year by selected characteristics and U.S. geographical location. **Methods:** Using data from the 2010-2014 National Survey on Drug Use and Health (NSDUH), we conducted bivariate chi-square tests to examine sociodemographic and selected behavioral indicators associated with buying marijuana and analyzed these factors in a multivariable logistic regression model. NSDUH participants were the noninstitutionalized civilian population aged 12+ (approximately 62,100 individuals per year) who reported using marijuana in the past year (approximately 12,400 annual average). **Results:** A weighted estimate of approximately 18.5 million individuals aged 12+ reported buying marijuana in the past year (59% of marijuana users). Overall, buyers of marijuana were more likely to be male, report using marijuana for a greater number of days, and to meet the criteria for substance use disorder and marijuana dependence. Data showed differences of proportion of marijuana buyers by state of residence. **Conclusions:** Given recent changes in state laws and policies and the increased demand for marijuana products, continued monitoring of the U.S. marijuana market in coming years is important in order to understand consumption and buying patterns among at-risk segments of the population, especially youth.

Hunt, P., & Pacula, R. L. (2017). Early Impacts of Marijuana Legalization: An Evaluation of Prices in Colorado and Washington. *The Journal of Primary Prevention*, 38(3), 221-248. doi:10.1007/s10935-017-0471-x.

Abstract: Following the legalization and regulation of marijuana for recreational purposes in states with medical markets, policymakers and researchers seek empirical evidence on how, and how fast, supply and demand changed over time. Prices are an indication of how suppliers and consumers respond to policy changes, so this study uses a difference-in-difference approach to exploit the timing of policy implementation and identify the impacts on marijuana prices 4-5 months after markets opened. This study uses unique longitudinal survey data of prices paid by consumers and a web-scraped dataset of dispensary prices advertised online for three U.S. medical marijuana states that all eventually legalized recreational marijuana. Results indicate there were no impacts on the prices paid for medical or recreational marijuana by state-representative residents within the short 4- to 5-months window following legalization. However, there were differences in how much people paid if they obtained marijuana for recreational purposes from a recreational store. Further analysis of advertised prices confirms this result, but further demonstrates heterogeneous responses in prices across types of commonly advertised strains; prices either did not change or increased depending on the strain type. A key implication of our findings is that there are both supply and demand responses at work in the opening of legalized markets, suggesting that evaluations of immediate effects may not accurately reflect the long run impact of legalization on consumption.

Jensen, E. L., & Roussell, A. (2016). Field observations of the developing legal recreational cannabis economy in Washington State. *International Journal of Drug Policy*, 33, 96-101. doi:10.1016/j.drugpo.2016.02.023.

Background: Washington State legalized the sale of recreational cannabis in 2012. This paper describes the unfolding of the market regulatory regime in an eastern portion of the state, including field descriptions to

illustrate the setting. **Methods:** We made observations and conducted interviews of the local supply chain comprising a producer/processor, analytic facility, and retail establishments as well as querying the state director of the regulatory board. **Results:** Interviews and observations of facilities suggest an overwhelming concern for black market diversion drives state regulatory efforts. The ongoing dialogue between market actors and the state has resulted in a more equitable distribution of profits at different stages in the process. State safety regulations have thus far been shifted to independent laboratories. Banks and insurance companies have slowly begun making inroads into the industry, despite federal prohibition. **Conclusion:** The law was conceived as a social justice remedy, but the bulk of the legal and regulatory activity surrounds cannabis marketplace management. This has been characterized by concerns for black market diversion, producer/processor profits, and a hands-off approach to safety regulation. Minor cannabis violations as a pathway to criminal justice system involvement have been reduced substantially but disproportionate enforcement upon racial/ethnic minorities continues.

Shanahan, M., & Ritter, A. (2014). Cost Benefit Analysis of Two Policy Options for Cannabis: Status Quo and Legalisation. *PLoS ONE*, 9(4). doi:10.1371/ journal.pone.0095569.

Aims: To date there has been limited analysis of the economic costs and benefits associated with cannabis legalisation. This study redresses this gap. A cost benefit analysis of two cannabis policy options the status quo (where cannabis use is illegal) and a legalised–regulated option was conducted. **Method:** A cost benefit analysis was used to value the costs and benefits of the two policies in monetary terms. Costs and benefits of each policy option were classified into five categories (direct intervention costs, costs or cost savings to other agencies, benefits or lost benefits to the individual or the family, other impacts on third parties, and adverse or spill over events). The results are expressed as a net social benefit (NSB). **Findings:** The mean NSB per annum from Monte Carlo simulations (with the 5 and 95 percentiles) for the status quo was \$294.6 million AUD (\$201.1 to \$392.7 million) not substantially different from the \$234.2 million AUD (\$136.4 to \$331.1 million) for the legalised–regulated model which excludes government revenue as a benefit. When government revenue is included, the NSB for legalised–regulated is higher than for status quo. Sensitivity analyses demonstrate the significant impact of educational attainment and wellbeing as drivers for the NSB result. **Conclusion:** Examining the percentiles around the two policy options, there appears to be no difference between the NSB for these two policy options. Economic analyses are essential for good public policy, providing information about the extent to which one policy is substantially economically favourable over another. In cannabis policy, for these two options this does not appear to be the case.

Vincent, P. C., Collins, R. L., Liu, L., Yu, J., Leo, J. A., & Earleywine, M. (2017). The Effects of Perceived Quality on Behavioral Economic Demand for Marijuana: A Web-Based Experiment. *Drug and Alcohol Dependence*, 170, 174-180. doi:10.1016/ j.drugalcdep.2016.11.013.

Background: Given the growing legalization of recreational marijuana use and related increase in its prevalence in the United States, it is important to understand marijuana's appeal. We used a behavioral economic (BE) approach to examine whether the reinforcing properties of marijuana, including "demand" for marijuana, varied as a function of its perceived quality. **Methods:** Using an innovative, Web-based marijuana purchase task (MPT), a sample of 683 young-adult recreational marijuana users made hypothetical purchases of marijuana across three qualities (low, mid and high grade) at nine escalating prices per joint, ranging from \$0/free to \$20. **Results:** We used nonlinear mixed effects modeling to conduct demand curve analyses, which produced separate demand indices (e.g., P_{max} , elasticity) for each grade of marijuana. Consistent with previous research, as the price of marijuana increased, marijuana users reduced their purchasing. Demand also was sensitive to quality, with users willing to pay more for higher quality/grade marijuana. In regression analyses, demand indices accounted for significant variance in typical marijuana use. **Conclusions:** This study illustrates the value of applying BE

theory to young adult marijuana use. It extends past research by examining how perceived quality affects demand for marijuana and provides support for the validity of a Web-based MPT to examine the appeal of marijuana. Our results have implications for policies to regulate marijuana use, including taxation based on the quality of different marijuana products.

Education

Cerdá, M., Wall, M., Feng, T., Keyes, K. M., Sarvet, A., Schulenberg, J., . . . Hasin, D. S. (2017). Association of State Recreational Marijuana Laws with Adolescent Marijuana Use. *JAMA Pediatrics*, 171(2), 142. doi:10.1001/jamapediatrics.2016.3624.

Importance: Historical shifts are occurring in marijuana policy. The effect of legalizing marijuana for recreational use on rates of adolescent marijuana use is a topic of considerable debate. **Objective:** To examine the association between the legalization of recreational marijuana use in Washington and Colorado in 2012 and the subsequent perceived harmfulness and use of marijuana by adolescents. **Design:** We used data of 253,902 students in eighth, 10th, and 12th grades from 2010 to 2015 from Monitoring the Future, a national, annual, cross-sectional survey of students in secondary schools in the contiguous United States. Difference-in-difference estimates compared changes in perceived harmfulness of marijuana use and in past-month marijuana use in Washington and Colorado prior to recreational marijuana legalization (2010-2012) with post legalization (2013-2015) vs the contemporaneous trends in other states that did not legalize recreational marijuana use in this period. **Main Outcomes:** Perceived harmfulness of marijuana use (great or moderate risk to health from smoking marijuana occasionally) and marijuana use (past 30 days). **Results:** Of the 253,902 participants, 120,590 of 245,065 (49.2%) were male, and the mean (SD) age was 15.6 (1.7) years. In Washington, perceived harmfulness declined 14.2% and 16.1% among eighth and 10th graders, respectively, while marijuana use increased 2.0% and 4.1% from 2010-2012 to 2013-2015. In contrast, among states that did not legalize recreational marijuana use, perceived harmfulness decreased by 4.9% and 7.2% among eighth and 10th graders, respectively, and marijuana use decreased by 1.3% and 0.9% over the same period. Difference-in-difference estimates comparing Washington vs states that did not legalize recreational drug use indicated that these differences were significant for perceived harmfulness (eighth graders: % [SD], -9.3 [3.5]; $P = .01$; 10th graders: % [SD], -9.0 [3.8]; $P = .02$) and marijuana use (eighth graders: % [SD], 5.0 [1.9]; $P = .03$; 10th graders: % [SD], 3.2 [1.5]; $P = .007$). No significant differences were found in perceived harmfulness or marijuana use among 12th graders in Washington or for any of the 3 grades in Colorado. **Conclusions:** Among eighth and 10th graders in Washington, perceived harmfulness of marijuana use decreased and marijuana use increased following legalization of recreational marijuana use. In contrast, Colorado did not exhibit any differential change in perceived harmfulness or past-month adolescent marijuana use following legalization. A cautious interpretation of the findings suggests investment in evidence-based adolescent substance use prevention programs in any additional states that may legalize recreational marijuana use.

Fischer, B., Russell, C., Sabioni, P., Brink, W. V., Foll, B. L., Hall, W., . . . Room, R. (2017). Lower-Risk Cannabis Use Guidelines: A Comprehensive Update of Evidence and Recommendations. *American Journal of Public Health*, 107(8), 1277-1277. doi:10.2105/ajph.2017.303818a.

Background: Cannabis use is common in North America, especially among young people, and is associated with a risk of various acute and chronic adverse health outcomes. Cannabis control regimes are evolving, for example toward a national legalization policy in Canada, with the aim to improve public health, and thus require evidence-based interventions. As cannabis-related health outcomes may be influenced by behaviors that are modifiable by the user, evidence-based Lower-Risk Cannabis Use Guidelines (LRCUG) — a kin to similar

guidelines in other health fields – offer a valuable, targeted prevention tool to improve public health outcomes.

Objectives: To systematically review, update, and quality-grade evidence on behavioral factors determining adverse health outcomes from cannabis that may be modifiable by the user, and translate this evidence into revised LRCUG as a public health intervention tool based on an expert consensus process. **Methods:** We used pertinent medical search terms and structured search strategies, to search MEDLINE, EMBASE, PsycINFO, Cochrane Library databases, and reference lists primarily for systematic reviews and meta-analyses, and additional evidence on modifiable risk factors for adverse health outcomes from cannabis use. **Selection Criteria:** We included studies if they focused on potentially modifiable behavior-based factors for risks or harms for health from cannabis use, and excluded studies if cannabis use was assessed for therapeutic purposes. **Data Collection and Analysis:** We screened the titles and abstracts of all studies identified by the search strategy and assessed the full texts of all potentially eligible studies for inclusion; 2 of the authors independently extracted the data of all studies included in this review. We created Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow-charts for each of the topical searches. Subsequently, we summarized the evidence by behavioral factor topic, quality-graded it by following standard (Grading of Recommendations Assessment, Development, and Evaluation; GRADE) criteria, and translated it into the LRCUG recommendations by the author expert collective on the basis of an iterative consensus process. **Main Results:** For most recommendations, there was at least "substantial" (i.e., good-quality) evidence. We developed 10 major recommendations for lower-risk use: (1) the most effective way to avoid cannabis use-related health risks is abstinence, (2) avoid early age initiation of cannabis use (i.e., definitively before the age of 16 years), (3) choose low-potency tetrahydrocannabinol (THC) or balanced THC-to-cannabidiol (CBD)-ratio cannabis products, (4) abstain from using synthetic cannabinoids, (5) avoid combusted cannabis inhalation and give preference to nonsmoking use methods, (6) avoid deep or other risky inhalation practices, (7) avoid high-frequency (e.g., daily or near-daily) cannabis use, (8) abstain from cannabis-impaired driving, (9) populations at higher risk for cannabis use-related health problems should avoid use altogether, and (10) avoid combining previously mentioned risk behaviors (e.g., early initiation and high-frequency use). **Conclusions:** Evidence indicates that a substantial extent of the risk of adverse health outcomes from cannabis use may be reduced by informed behavioral choices among users. The evidence-based LRCUG serve as a population-level education and intervention tool to inform such user choices toward improved public health outcomes. However, the LRCUG ought to be systematically communicated and supported by key regulation measures (e.g., cannabis product labeling, content regulation) to be effective. All of these measures are concretely possible under emerging legalization regimes, and should be actively implemented by regulatory authorities. The population-level impact of the LRCUG toward reducing cannabis use-related health risks should be evaluated. **Public health implications:** Cannabis control regimes are evolving, including legalization in North America, with uncertain impacts on public health. Evidence-based LRCUG offer a potentially valuable population-level tool to reduce the risk of adverse health outcomes from cannabis use among (especially young) users in legalization contexts, and hence to contribute to improved public health outcomes.

Ghosh, T. S., Dyke, M. V., Maffey, A., Whitley, E., Erpelding, D., & Wolk, L. (2015). Medical Marijuana's Public Health Lessons — Implications for Retail Marijuana in Colorado. *New England Journal of Medicine*, 372(11), 991-993. doi:10.1056/nejmp1500043.

In 2000, Colorado residents voted to legalize marijuana use for medical conditions such as glaucoma, HIV/AIDS, cancer, seizures, and severe pain. From 2000 to 2009, medical marijuana was available in Colorado only from plants grown in noncommercial, home settings, and the number of medical users or registrants remained relatively small. But in 2010, state law was changed to permit commercial production and distribution of medical marijuana. The number of registrants (both adults and children) grew rapidly – from 4819 in December 2008 to 115,467 in December 2014 – and medical marijuana dispensaries proliferated. Then, on January 1, 2014, Colorado became the first U.S. state to allow sales of recreational, or retail, marijuana. With no state models or national guidance to follow, Colorado public health officials have turned to lessons from medical

marijuana to prepare for the potential public health implications of more widely available recreational marijuana.

Ghosh, T., Dyke, M. V., Maffey, A., Whitley, E., Gillim-Ross, L., & Wolk, L. (2016). The Public Health Framework of Legalized Marijuana in Colorado. *American Journal of Public Health, 106*(1), 21-27.

doi:10.2105/ajph.2015.302875.

On January 1, 2014, Colorado became the first state in the nation to sell legal recreational marijuana for adult use. As a result, Colorado has had to carefully examine potential population health and safety impacts as well as the role of public health in response to legalization. We have discussed an emerging public health framework for legalized recreational marijuana. We have outlined this framework according to the core public health functions of assessment, policy development, and assurance. In addition, we have discussed challenges to implement this framework that other states considering legalization may face.

Ghosh, T. S., Vigil, D. I., Maffey, A., Tolliver, R., Dyke, M. V., Kattari, L., . . . Wolk, L. (2017). Lessons Learned After Three Years of Legalized, Recreational Marijuana: The Colorado Experience. *Preventive Medicine, 104*, 4-6. doi:10.1016/j.ypmed. 2017.02.021.

Abstract: In November 2012, Colorado voters approved legalized recreational marijuana. On January 1, 2014, Colorado became the first state to allow legal sales of non-medical marijuana for adults over the age of 21. Since that time, the state has been monitoring potential impacts on population health. In this paper, we present lessons learned in the first three years following legal sales of recreational marijuana. These lessons pertain to health behaviors and health outcomes, as well as to health policy issues. Our intent is to share these lessons with other states as they face the prospect of recreational marijuana legalization.

Hanson, K., Haggerty, K. P., Fleming, C. B., Skinner, M. L., Casey-Goldstein, M., Mason, W. A., . . . Redmond, C. (2018). Washington State Retail Marijuana Legalization: Parent and Adolescent Preferences for Marijuana Messages in a Sample of Low-Income Families. *Journal of Studies on Alcohol and Drugs, 79*(2), 309-317. doi:10.15288/jsad.2018.79.309.

Objective: As legalization of nonmedical retail marijuana increases, states are implementing public health campaigns designed to prevent increases in youth marijuana use. This study investigated which types of marijuana-related messages were rated most highly by parents and their teens and whether these preferences differed by age and marijuana use. **Method:** Nine marijuana-focused messages were developed as potential radio, newspaper, or television announcements. The messages fell into four categories: information about the law, general advice/conversation starters, consequences of marijuana use/positive alternatives, and information on potential harmful effects of teen marijuana use. The messages were presented through an online survey to 282 parents (84% female) and 283 teen (54% female) participants in an ongoing study in Washington State.

Results: Both parents and youth rated messages containing information about the law higher than other types of messages. Messages about potential harms of marijuana use were rated lower than other messages by both generations. Parents who had used marijuana within the past year (n = 80) rated consequence/positive alternative messages lower than parent nonusers (n = 199). Youth marijuana users (n = 77) and nonusers (n = 202) both rated messages containing information about the law higher than other types of messages. Youth users and nonusers were less likely than parents to believe messages on the harmful effects of marijuana.

Conclusions: The high ratings for messages based on information about the marijuana law highlight the need for informational health campaigns to be established as a first step in the marijuana legalization process.

Harpin, S. B., Brooks-Russell, A., Ma, M., James, K. A., & Levinson, A. H. (2017). Adolescent Marijuana Use and Perceived Ease of Access Before and After Recreational Marijuana Implementation in Colorado. *Substance Use & Misuse*, 53(3), 451-456. doi:10.1080/10826084.2017.1334069.

Background: As of January 1, 2017, eight states have approved laws for recreational marijuana use. While the social impacts of these changes remain under debate, the influence on adolescent marijuana use is a key policy and health issue across the U.S. **Objective:** To examine changes in adolescent marijuana-use behaviors in the first year after recreational marijuana implementation in Colorado, and to analyze the effect of retail marijuana store proximity on youth use and perceptions. **Method:** Secondary analysis of Healthy Kids Colorado Survey data from 40 schools surveyed before and after recreational marijuana sales were implemented (2013 student n = 12,240; 2014 student n = 11,931). Self-reported marijuana use, ease of access, and perceived harms were compared between years and by proximity of recreational marijuana stores to surveyed schools. **Results:** Adolescent marijuana use behaviors, wrongness of use, and perceptions of risk of harm were unchanged from baseline to one-year follow-up. Perceived ease of access to marijuana increased (from 46% to 52%). Proximity of recreational marijuana stores was not significantly associated with perceived ease of access to marijuana. **Conclusions/Importance:** In the first study of adolescent marijuana use and perceptions after state retail implementation of recreational marijuana, there was little change in adolescent marijuana use but a significant change in perception of ease of access. Public health workers and policymakers should continue to monitor these changes as essential for evaluating the impact of liberalization of marijuana policies.

Hasin, D. S. (2017). US Epidemiology of Cannabis Use and Associated Problems. *Neuropsychopharmacology*, 43(1), 195-212. doi:10.1038/npp.2017.198.

Abstract: This review provides an overview of the changing US epidemiology of cannabis use and associated problems. Adults and adolescents increasingly view cannabis as harmless, and some can use cannabis without harm. However, potential problems include harms from prenatal exposure and unintentional childhood exposure; decline in educational or occupational functioning after early adolescent use, and in adulthood, impaired driving and vehicle crashes; cannabis use disorders (CUD), cannabis withdrawal, and psychiatric comorbidity. Evidence suggests national increases in cannabis potency, prenatal and unintentional childhood exposure; and in adults, increased use, CUD, cannabis-related emergency room visits, and fatal vehicle crashes. Twenty-nine states have medical marijuana laws (MMLs) and of these, 8 have recreational marijuana laws (RMLs). Many studies indicate that MMLs or their specific provisions did not increase adolescent cannabis use. However, the more limited literature suggests that MMLs have led to increased cannabis potency, unintentional childhood exposures, adult cannabis use, and adult CUD. Ecological-level studies suggest that MMLs have led to substitution of cannabis for opioids, and also possibly for psychiatric medications. Much remains to be determined about cannabis trends and the role of MMLs and RMLs in these trends. The public, health professionals, and policy makers would benefit from education about the risks of cannabis use, the increases in such risks, and the role of marijuana laws in these increases.

Maggs, J. L., Staff, J., Kloska, D. D., Patrick, M. E., Omalley, P. M., & Schulenberg, J. (2015). Predicting Young Adult Degree Attainment by Late Adolescent Marijuana Use. *Journal of Adolescent Health*, 57(2), 205-211. doi:10.1016/j.jadohealth. 2015.04.028.

Purpose: The purpose of this study was to assess whether infrequent and frequent marijuana use at age 19/20 years predicts receipt of educational degrees by the mid-20s, independent of confounding age 18 adolescent risk factors. **Methods:** Data were from the Monitoring the Future study, an annual nationally representative survey of high school seniors followed into adulthood. Thirteen cohorts (1990-2002) of high school seniors were followed longitudinally to their mid-20s (n = 4,925; 54% female). We used logistic regression and propensity

score matching with successive inclusion of age 18 risk factors and substance use to compare age 19/20 frequent marijuana users (six or more occasions in past 30 days) to nonusers, frequent users to infrequent users (1-6 occasions), and infrequent users to nonusers on their likelihood of degree attainment by the mid-20s.

Results: Frequent marijuana users were less likely than infrequent users and nonusers to earn bachelor's degrees, even after controlling for a host of age 18 risk factors (e.g., family socioeconomic background, academic performance, educational expectations, truancy). However, these differences were reduced in magnitude to statistical nonsignificance when we controlled for age 18 substance use. Across analyses, the proportion reaching this educational milestone did not differ significantly between infrequent users and nonusers. **Conclusions:** Results support a growing body of work suggesting that frequent marijuana use predicts a lower likelihood of postsecondary educational attainment, and this difference may originate during secondary school.

Nadelmann, E., & Lasalle, L. (2017). Two Steps Forward, One Step Back: Current Harm Reduction Policy and Politics in the United States. *Harm Reduction Journal*, 14(1). doi:10.1186/s12954-017-0157-y.

Abstract: Harm reduction policies and attitudes in the United States have advanced substantially in recent years but still lag behind more advanced jurisdictions in Europe and elsewhere. The Obama administration, particularly in its last years, embraced some harm reduction policies that had been rejected by previous administrations but shied away from more cutting edge interventions like supervised consumption sites and heroin-assisted treatment. The Trump administration will undermine some of the progress made to date but significant state and local control over drug policies in the US, as well as growing Republican support for pragmatic drug policies, motivated in part by the opioid crisis, ensures continuing progress for harm reduction.

Pacula, R. L., Kilmer, B., Wagenaar, A. C., Chaloupka, F. J., & Caulkins, J. P. (2014). Developing Public Health Regulations for Marijuana: Lessons from Alcohol and Tobacco. *American Journal of Public Health*, 104(6), 1021-1028. doi:10.2105/ajph.2013.301766.

Abstract: Until November 2012, no modern jurisdiction had removed the prohibition on the commercial production, distribution, and sale of marijuana for nonmedical purposes – not even the Netherlands. Government agencies in Colorado and Washington are now charged with granting production and processing licenses and developing regulations for legal marijuana, and other states and countries may follow. Our goal is not to address whether marijuana legalization is a good or bad idea but, rather, to help policymakers understand the decisions they face and some lessons learned from research on public health approaches to regulating alcohol and tobacco over the past century.

Palamar, J. J., Ompad, D. C., & Petkova, E. (2014). Correlates of Intentions to Use Cannabis Among US High School Seniors in the Case of Cannabis Legalization. *International Journal of Drug Policy*, 25(3), 424-435. doi:10.1016/j.drugpo. 2014.01.017.

Background: Support for cannabis ("marijuana") legalization is increasing in the United States (US). Use was recently legalized in two states and in Uruguay, and other states and countries are expected to follow suit. This study examined intentions to use among US high school seniors if cannabis were to become legally available. **Methods:** Data from the last five cohorts (2007-2011) of high school seniors in Monitoring the Future, an annual nationally representative survey of students in the US were utilized. Data were analyzed separately for the 6116 seniors who reported no lifetime use of cannabis and the 3829 seniors who reported lifetime use (weighted Ns). We examined whether demographic characteristics, substance use and perceived friend disapproval towards cannabis use were associated with (1) intention to try cannabis among non-lifetime users, and (2) intention to use cannabis as often or more often among lifetime users, if cannabis was legal to use. **Results:** Ten percent of

non-cannabis-using students reported intent to initiate use if legal and this would be consistent with a 5.6% absolute increase in lifetime prevalence of cannabis use in this age group from 45.6% (95% CI=44.6, 46.6) to 51.2% (95% CI=50.2, 52.2). Eighteen percent of lifetime users reported intent to use cannabis more often if it was legal. Odds for intention to use outcomes increased among groups already at high risk for use (e.g., males, whites, cigarette smokers) and odds were reduced when friends disapproved of use. However, large proportions of subgroups of students normally at low risk for use (e.g., non-cigarette-smokers, religious students, those with friends who disapprove of use) reported intention to use if legal. Recent use was also a risk factor for reporting intention to use as often or more often. **Conclusion:** Prevalence of cannabis use is expected to increase if cannabis is legal to use and legally available.

Rehm, J., Crépault, J., & Fischer, B. (2016). The Devil Is in the Details! On Regulating Cannabis Use in Canada Based on Public Health Criteria Comment on "Legalizing and Regulating Marijuana in Canada: Review of Potential Economic, Social, and Health Impacts". *International Journal of Health Policy and Management*, 6(3), 173-176. doi:10.15171/ijhpm.2016.114.

Abstract: This commentary to the editorial of Hajizadeh argues that the economic, social and health consequences of legalizing cannabis in Canada will depend in large part on the exact stipulations (mainly from the federal government) and on the implementation, regulation and practice of the legalization act (on provincial and municipal levels). A strict regulatory framework is necessary to minimize the health burden attributable to cannabis use. This includes prominently control of production and sale of the legal cannabis including control of price and content with ban of marketing and advertisement. Regulation of medical marijuana should be part of such a framework as well.

Rehm, J., & Fischer, B. (2015). Cannabis Legalization with Strict Regulation, the Overall Superior Policy Option for Public Health. *Clinical Pharmacology & Therapeutics*, 97(6), 541-544. doi:10.1002/cpt.93.

Abstract: Cannabis is the most prevalently used drug globally, with many jurisdictions considering varying reform options to current policies to deal with this substance and associated harm. Three policy options are available: prohibition, decriminalization, and legalization, with prohibition currently the dominant model globally. This contribution gives reasons why legalization with strict regulation should be considered superior to other options with respect to public health in high income countries in North America.

Smith, R., Hall, K. E., Etkind, P., & Dyke, M. V. (2018). Current Marijuana Use by Industry and Occupation — Colorado, 2014–2015. *MMWR. Morbidity and Mortality Weekly Report*, 67(14), 409-413. doi:10.15585/mmwr.mm6714a1.

Abstract: The effects of marijuana use on workplace safety are of concern for public health and workplace safety professionals. Twenty-nine states and the District of Columbia have enacted laws legalizing marijuana at the state level for recreational and/or medical purposes. Employers and safety professionals in states where marijuana use is legal have expressed concerns about potential increases in occupational injuries, such as on-the-job motor vehicle crashes, related to employee impairment. Data published in 2017 by the Colorado Department of Public Health and Environment (CDPHE) showed that more than one in eight adult state residents aged ≥18 years currently used marijuana in 2014 (13.6%) and 2015 (13.4%) (1). To examine current marijuana use by working adults and the industries and occupations in which they are employed, CDPHE analyzed data from the state's Behavioral Risk Factor Surveillance System (BRFSS) regarding current marijuana use (at least 1 day during the preceding 30 days) among 10,169 persons who responded to the current marijuana use question. During 2014 and 2015, 14.6% of these 10,169 Colorado workers reported current marijuana use, with the highest reported prevalence among workers in the Accommodation and Food Services

industry (30.1%) and Food Preparation and Serving (32.2%) occupations. Understanding the industries and occupations of adults with reported marijuana use can help direct and maximize impact of public health messaging and potential safety interventions for adults.

Thompson, K., Leadbeater, B., Ames, M., & Merrin, G. J. (2018). Associations Between Marijuana Use Trajectories and Educational and Occupational Success in Young Adulthood. *Prevention Science*. doi:10.1007/s11121-018-0904-7.

Abstract: Adolescence and young adulthood is a critical stage when the economic foundations for life-long health are established. To date, there is little consensus as to whether marijuana use is associated with poor educational and occupational success in adulthood. We investigated associations between trajectories of marijuana use from ages 15 to 28 and multiple indicators of economic well-being in young adulthood including achievement levels (i.e., educational attainment and occupational prestige), work characteristics (i.e., full vs part-time employment, hours worked, annual income), financial strain (i.e., debt, trouble paying for necessities, delaying medical attention), and perceived workplace stress. Data were from the Victoria Healthy Youth Survey, a 10-year prospective study of a randomly recruited community sample of 662 youth (48% male; $M_{age} = 15.5$), followed biennially for six assessments. Models adjusted for baseline age, sex, SES, high school grades, heavy drinking, smoking, and internalizing and oppositional defiant disorder symptoms. Chronic users (our highest risk class) reported lower levels of educational attainment, lower occupational prestige, lower income, greater debt, and more difficulty paying for medical necessities in young adulthood compared to abstainers. Similarly, increasers also reported lower educational attainment, occupational prestige, and income. Decreasers, who had high early use but quit over time, showed resilience in economic well-being, performing similar to abstainers. Groups did not differ on employment status or perceived workplace stress. The findings indicate that early onset and persistent high or increasingly frequent use of marijuana in the transition from adolescent to young adulthood is associated with risks for achieving educational and occupational success, and subsequently health, in young adulthood.

Appendix C: Comparative Review of State Laws Legalizing Regulated Marijuana Use

Comparative Review of State Laws Legalizing Recreational Marijuana Use

The information in this grid was adapted from the National Alliance for Model State Drug Laws (NAMSDL) document titled [Marijuana: Comparison of State Laws Legalizing Personal, Non-Medical Use](#). The National Alliance for Model State Drug Laws is funded by congressional appropriations and is the non-profit successor to The President's Commission on Model State Drug Laws. In coordination with the Office of National Drug Control Policy, the NAMSDL drafts model drug and alcohol laws, policies and regulations, and analyzes existing state statutes.

Regulations corresponding with the states of Alaska, California, Colorado, Massachusetts, Nevada, Oregon and Washington were cross-referenced against each state government website and updated accordingly. These states, which have legalized regulated marijuana use and set forth regulations on state government websites, are outlined in this document. Washington D.C., which permits home cultivation only, has been excluded. It should be noted that efforts to legalize marijuana production and use continue in many states, including in Maine, where a ballot initiative legalized marijuana possession but regulations for the retail market have not yet been established.

Note: Information corresponding to a particular state/regulation may have not been available at the time this document was developed. Such instances are indicated with 'NA'.

All information contained in this document is current as of April 30, 2018.

Comparative Review of State Laws Legalizing Regulated Marijuana Use									
Overview		Alaska	California	Colorado	Massachusetts	Nevada	Oregon	Washington	Shared Rationale
	Effective Date	02/24/2015	11/09/2016	12/10/2012	12/15/2016	01/01/2017	07/01/2015	12/06/2012	All states represented in this document have enacted marijuana legislation into law and developed associated regulation for production, sales and consumption.
	Regulating authority	Marijuana Control Board	Bureau of Marijuana Control; Department of Consumer Affairs; Department of Food and Agriculture; Department of Public Health	Marijuana Enforcement Division; Department of Revenue	Cannabis Control Commission	Nevada Department of Taxation	Oregon Liquor Control Commission; Oregon Health Authority; Oregon Department of Revenue	Washington Liquor and Cannabis Control Board	
	Studies required of or requested by regulating authority	NA	Research/evaluation of implementation and effect of the law, including determination of impairment by use of marijuana while driving	Examination of law enforcement activity and costs related to marijuana use in 2006-2007 compared to 2014-2015	Cannabis Advisory Board responsible for examining regulation of marijuana/ marijuana products	NA	Investigate influence of marijuana on driving ability	NA	

Supply Chain		Alaska	California	Colorado	Massachusetts	Nevada	Oregon	Washington	Shared Rationale
	Retail	✓	✓	✓	✓	✓	✓	✓	
	Cultivation	✓	✓	✓	✓	✓	✓	✓	
	Manufacturers/ Processors	✓	✓	✓	✓	✓	✓	✓	
	Testing	✓	✓	✓	✓	✓	✓	✓	
	Other	NA	Micro-businesses	Transporters	NA	Distributors	Wholesalers	Transporters	

Home Cultivation		Alaska	California	Colorado	Massachusetts	Nevada	Oregon	Washington	Shared Rationale
	Home cultivation permitted	✓	✓	✓	✓	✓	✓	Not permitted	Home cultivation is allowed in all states except Washington. In states where home cultivation is allowed, plants and marijuana cannot be visible from public places with unaided vision and must take place in an enclosed and locked area. Homemade
	Maximum number of plants/mature per individual	6/3	6/NA	6/3	6/NA	6/NA	4/NA		
	Maximum number of plants/mature per household	12/6	6/NA	12/NA	12/NA	12/NA	12/4 (or 10 seeds)		
	Noncommercial transfer limit	1 oz. or 6 plants	1 oz.	1 oz.	1 oz.	NA	NA		
	Excess limits and repercussions	NA	Plants and marijuana produced >28.5 oz. must be secured by a lock; not visible by normal	NA	Failure to keep marijuana > 1 oz. locked up within the home punishable by a \$100 fine/ forfeiture of marijuana.	Unless an agent of a cultivation facility, not allowed to cultivate within 25 miles of a licensed	NA		

			unaided vision from a public space.			retailer. 1st violation misdemeanor fines up to \$600.			products may be transferred (not sold) to another person age 21 or older in some states.
	Maximum amount of residential possession	Possession of marijuana produced by the plants on premises where the plants were grown is permitted.	NA	NA	10 oz. of home cultivated marijuana; > 1 oz. of marijuana must be secured by a lock	NA	8 oz. useable marijuana		

Current State of Market		Alaska	California	Colorado	Massachusetts	Nevada	Oregon	Washington	Shared Rationale
	Retail licenses	59	NA	529	Retail market was not operational at the time this document was produced.	NA	345	756	The number of licenses granted may be restricted by municipalities.
	Cultivation/producer licenses	128 (includes "standard" and "limited" cultivation facilities)	NA	735		NA	23	1,465	
	Manufacturing/processors	11	NA	284		NA	19	1,572	
	Testing licenses	3	NA	12		NA	104 wholesalers	17	
	Other licenses	201 are currently operational. 508 additional applications are at various stages of the review process.	NA	8 operators; 9 transporters		NA	345	917 producers/processors; 37 transporters	

Amount of Marijuana Permitted for Personal Use		Alaska	California	Colorado	Massachusetts	Nevada	Oregon	Washington	Shared Rationale
	Flower	1 oz.	28.5 gr.	1 oz.	1 oz.	1 oz.	1 oz. of useable marijuana in a public place	1 oz.	Must be 21 years or older to possess, purchase or consume marijuana.
	Concentrated	7 gr.	8 gr.	8 gr.	5 gr.	12.5% of 1 oz.	5 gr.	7 gr.	
	Liquid	NA	NA	NA	NA	NA	72 oz.	72 oz.	
	Solid	NA	NA	NA	NA	NA	16 oz.	16 oz.	Products permitted: herbal, edible, infused products, tinctures, concentrates.
	Maximum amount in one transaction	5,600 mg. of THC	NA	NA	NA	NA	NA	NA	
	Maximum amount for non-commercial transfer	NA	NA	1 oz	NA	1 oz., or 1/8 oz. if concentrate	NA	NA	

Restrictions on Marijuana Consumption/Personal Use Regulations									
		Alaska	California	Colorado	Massachusetts	Nevada	Oregon	Washington	Shared Rationale
	Overview of general restrictions	Up to \$400 for providing false ID, \$100 for public consumption; consumption permitted on premises of licensed retailer designated for onsite consumption.	Cannot possess or smoke within 1,000 feet of a school, day care or youth center while children are present; on the grounds of, or within, any correctional facility.	Class 2 misdemeanor for an underage person to buy or possess retail marijuana.	Cannot possess or smoke within a public or private school or any correctional facility.	Cannot possess or smoke within a public or private school or any correctional facility.	Cannot give marijuana to anyone who is visibly intoxicated. Cannot import or export marijuana from Oregon.	Illegal to either open a package containing marijuana or consume marijuana "in view of the general public."	Must be 21 years or older to possess, purchase or consumed marijuana; not permitted in public; cannot possess or consume on federal property.
	Local control	Local government entities (city/town, county) may prohibit the operation of marijuana establishments or impose restrictions on operations as a result of voter initiatives or local ordinances. The restrictions may impact retailers, manufacturers, and cultivators. This includes limits to the number of establishments permitted and establishment of civil penalties for violations.							
	Employer restrictions	Employers may restrict or prohibit use, consumption, possession, and transfer of marijuana in the workplace.							
Driving During/After Use	Specified THC level in blood	NA	NA	>=5.0 ng/ml	NA	>=2 ng/ml	NA	>=5.0 ng/ml	In all listed states, it is illegal to operate a motor vehicle under the influence of any controlled substance,
	Specified THC level in urine	NA	NA	NA	NA	>=10 ng/ml	NA	NA	
	Possession of marijuana while operating	NA	✓	✓	✓	NA	NA	NA	

		vehicle is illegal								including marijuana.
		Open container in vehicle	NA	May not possess an open container of marijuana while driving	Passengers may not possess open containers of marijuana	Possession of open container may result in fine of up to \$500	NA	NA	NA	Law enforcement officers may base DUI arrest on observed impairment.
	Exemption from penalty provided by law		Marijuana and marijuana products possessed and used in accordance with state laws are not subject to seizure and may not be the basis for arrest.							

Marijuana Establishments			Alaska	California	Colorado	Massachusetts	Nevada	Oregon	Washington	Shared Rationale
	Application Process	Background check	NA	✓	✓	✓	✓	NA	Washington State Liquor and Cannabis Board have no plan to open the window for new retail or producer licenses as of 4/30/18.	
		90-day turnaround on applications	✓	NA	✓	✓	✓	✓		
		Priority to existing medical marijuana establishments	NA	✓	NA	✓	✓	NA		
	Application Fees	New/Initial	\$1,000	\$1,000	\$500	Cannot exceed \$3,000	\$5,000	\$250	\$250	
		Renewal	\$600	NA	\$300	NA	NA	NA	NA	
		Handler/agent permit	\$50	NA	\$75-\$250	NA	\$75	\$100	NA	

Marijuana Establishments			Alaska	California	Colorado	Massachusetts	Nevada	Oregon	Washington	Shared Rationale
	License Fees	Retail	\$5000	Licensing and renewal fees based upon size of business, \$4,000-\$72,000; \$5,000 surety bond	Up to \$4,900	Cannot exceed \$15,000	Initial, max fee \$20,000; renewal, max fee: \$6,600	\$4,750	\$1,480	Licenses valid for 1 year. Massachusetts began accepting applications from subgroups of prospective licensees on April 17, 2018. All other license types may start the application process between May 1, 2018 and June 1, 2018.
		Cultivation/producer	\$1,000 - \$5,000			Cannot exceed \$15,000	Initial, max fee \$30000; renewal, max fee \$10,000	\$1,000-\$5,750 based on size of production	\$1,480	
		Manufacturing/Processor	\$1,000 - \$5,000			Cannot exceed \$15,000	Initial, max fee \$10000; renewal, max fee \$3,300	\$4,750	\$1,480	
		Testing	\$1,000			Cannot exceed \$10,000	Initial, max fee \$15,000; renewal, max fee \$5,000	\$4,750	NA	
		Distributor	NA			NA	Initial, max fee \$15,000; renewal, max fee \$5,000	NA	NA	

			Alaska	California	Colorado	Massachusetts	Nevada	Oregon	Washington	Shared Rationale
Marijuana Establishments	Establishment Restrictions	Licensee should be 21 years or older	✓	✓	✓	✓	✓	✓	✓	All states require conduct fingerprint-based background checks prior to granting a license. Most states prohibit previous substance-related commercial convictions with the exception of Massachusetts. Oregon evaluates the relevance of prior criminal records case by case. Some states are working toward expunging previous drug related offenses.
		Joint medical/retail marijuana establishment allowed	NA	NA	✓	✓	✓	NA	✓	
		Criminal conviction restrictions	Convicted of a felony and either (1) less than 5 years have elapsed since conviction or (2) person is on probation or parole for that felony	No prior record of felony/no substance related misdemeanor.	No prior record of controlled substance-related felony in the past 10 years/no felony in the past 5 years.	No prior record of felony (unless it solely involved the distribution of marijuana to adults).	No conviction of any "excluded felony offense", no previous license revocation.	No conviction to state or federal law violations relevant to the business. No specifically set criteria.	NA	
		No record of alcohol sales	✓	✓	NA	NA	NA	NA	NA	
		No record of unauthorized substance sales	✓	✓	✓	NA	✓	NA	NA	
		Other	No alcohol sales within the last 5 years	Cannot be a licensed retailer of alcohol or tobacco	License cannot be granted to law enforcement	NA	NA	License cannot be granted to habitual users of excess alcohol or other drugs	NA	

		Alaska	California	Colorado	Massachusetts	Nevada	Oregon	Washington	Shared Rationale
Marijuana Establishments	Operational Restrictions and Requirements for Retail Establishments	Distance requirements	School: 500 ft.	School: 600 ft.	School: 1000 ft.	School: 500 ft.	School: 1,000 ft.; community facility 300 ft.	School: 1,000 ft.	School and other community facilities that are not excluded for adults: 1,000 ft.
		Hours of operation	Sales Prohibited between 5:00 am and 8:00 am	Sales prohibited between 10pm and 6am	Varies by municipality	NA	Varies by municipality	Sales allowed between 7:00 am and 10:00 pm	Sales allowed between 8:00 am and 12:00 am
		Customer must show ID	✓	✓	✓	NA	✓	✓	✓
		Insurance	NA	May be available but not required, varies by municipality	NA	NA	NA	Licensee may require an affordable general liability insurance.	Licensee must carry and maintain commercial general liability insurance and if necessary, commercial umbrella insurance.
		Store shall <u>not</u> be located in an establishment with liquor license	✓	NA	NA	NA	NA	✓	NA
		Substance shall <u>not</u> be visible to the public	✓	NA	NA	✓	✓	NA	NA

			Alaska	California	Colorado	Massachusetts	Nevada	Oregon	Washington	Shared Rationale
Marijuana Establishments	Operational restrictions and requirements	Maximum amount of THC per serving size	≤ 5 mg THC	< 10 mg THC	< 10 mg THC	NA	< 10 mg THC	≤ 5 mg THC	< 10 mg THC	
		Maximum Servings per package	50 mg THC	NA	100 mg THC	NA	NA	50 mg THC	100 mg THC	
		Other regulations	Handlers must complete an education course and pass a written test; liquid and solid edibles must be homogenized to ensure uniform disbursement of cannabinoids	NA	All employees shall be residents of Colorado. Online sales not allowed.	NA	Number of retailers is limited by population of county. A county may file a request for additional stores.	May not be located in residential areas; delivery allowed in certain circumstances but only between 8 am and 9pm.	Maximum amount of inventory for retail: up to four months of their average supplies. No vending machine or drive through Food requiring temperature control shall not be infused with marijuana.	

			Alaska	California	Colorado	Massachusetts	Nevada	Oregon	Washington	Shared Rationale
Marijuana Establishments	Labelling & Packaging	Cannot label products to be appealing to minors	✓	✓	NA	NA	✓	✓	NA	General consensus on labeling: Identification of the marijuana cultivator/ manufacturer; amount of THC per serving/package; name and logo of cultivator; keep out of reach of children. Some states require disclosure of all pesticides applied during production and processing. Packaging should be certified to be child resistant by a third-party
		Third-party-certified child-resistant packaging required	✓	✓	NA	NA	✓	✓	NA	
		‘Contains marijuana’ symbol/text required on packaging	✓	✓	✓	✓	NA	NA	✓	
		Explanation of warnings required on packaging	1) This product has intoxicating effects and may be habit forming. Smoking is hazardous to your health. 2) There may be health risks associated with the consumption of this product. 3) Should not be used by women who are pregnant or breast feeding. 4) For use only by adults 21 and older. 5) Marijuana can impair concentration, coordination, and judgment. Do not operate a vehicle or machinery under the influence of this drug.							
	Advertising	May not contain false or misleading information	✓	NA	✓	✓	✓	✓	✓	
		May not promote excessive consumption	✓	NA	NA	NA	✓	✓	✓	
		May not depict someone under 21 consuming marijuana	✓	NA	NA	✓	NA	✓	✓	

		May not promote transport across state lines/target out of state consumers	NA	NA	✓	NA	✓	✓	NA	firm. Package should be resealable in case it includes multiple servings. Packaging should be opaque. Advertising restrictions vary, but many states ban advertising within a certain distance of schools, limit the amount of signage outside an establishment and restrict online marketing and/or marketing to a mobile device.
		Cannot advertise on TV/radio/print unless...	NA	71.6% of audience is expected to be 21 or older	70% of audience is 21 or older; outdoor advertising generally prohibited	85% of audience is 21 or older	70% of audience is 21 or older	NA	NA	
		May not claim curative or therapeutic benefits	✓	NA	✓	NA	NA	✓	✓	

			Alaska	California	Colorado	Massachusetts	Nevada	Oregon	Washington	Shared Rationale	
Marijuana Establishments	Monitoring/inspections	Inspection of physical premises/establishment	✓	✓	✓	✓	✓	✓	✓	The (METRC) System is used as a means to record inventory and movement of marijuana through the supply chain.	
		Inspection by local fire department/code inspector	NA	✓	✓	NA	✓	NA	NA		
		Examination of business and financial records	✓	✓	✓	✓	✓	✓	✓		
		Confirmation of qualifications of personnel	✓	NA	NA	NA	✓	NA	NA		
		Testing	Laboratory testing is required on samples of all marijuana or marijuana products which may include potency testing (THC content), microbial testing, testing for pesticides and other contaminants.								Other “Seed to Sale” databases may be used
		Tracking System: Marijuana Enforcement Tracking Reporting & Compliance (METRC)	✓	✓	✓	NA	✓	✓	NA		
		Tracking System: Other	NA	NA	NA	✓	NA	NA	✓		
		Other	NA	NA	NA	Secret shopper program	NA	NA	NA		

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