
Syracuse University

Maxwell School of Citizenship and Public Affairs | Center for Policy Research

Policy Brief

Marijuana Legalization:
Beyond Yes or No

Keith Humphreys

No. 55/2019

Dr. Keith Humphreys is the Esther Ting Memorial Professor at Stanford University and a Senior Research Career Scientist at the VA Health Services Research Center in Palo Alto. His research addresses the prevention and treatment of addictive disorders, the formation of public policy about addiction and mental health, and transfer of knowledge from clinical trials into clinical practice. Humphreys has published over 300 scientific articles including papers in *New England Journal of Medicine*, *Science*, *JAMA*, *Lancet*, and *Addiction*. He is also a regular contributor at *The Washington Post*. In addition to his scientific work, Dr. Humphreys has been extensively involved in the formation of public policy, having served as a member of the White House Commission on Drug Free Communities, the VA National Mental Health Task Force, the National Advisory Council of the U.S. Substance Abuse and Mental Health Services Administration, and the California Blue Ribbon Commission on Marijuana Policy. During the Obama Administration, he spent a sabbatical year as Senior Policy Advisor at the White House Office of National Drug Control Policy. He has also testified on numerous occasions in Congress, in state legislatures, and in the U.K. Parliament.

The Herbert Lourie Memorial Lecture on Health Policy, sponsored by the Maxwell School of Citizenship and Public Affairs of Syracuse University and the Central New York Community Foundation, Inc., honors the memory of Herbert Lourie, MD, a distinguished Syracuse neurosurgeon, professor, and community leader for nearly 30 years. Generous contributions from his family, friends and colleagues, and former patients have endowed this series.

The Policy Brief series is a collection of essays on current public policy issues in aging; urban and regional studies; education finance and accountability; public finance; social welfare, poverty, and income security; and related research done by or on behalf of the Center for Policy Research (CPR) at the Maxwell School of Syracuse University.

Single copies of this publication may be downloaded at no cost from the CPR website at <http://www.maxwell.syr.edu/cpr> or ordered from the Center for Policy Research, 426 Eggers Hall, Syracuse, New York 13244-1020.

© 2019, Syracuse University. This publication may be distributed freely for educational and research uses as long as this copyright notice is attached. No commercial use of this material may be made without express written permission.

Policy Brief

Marijuana Legalization:
Beyond Yes or No

Keith Humphreys

Marijuana Legalization: Beyond Yes or No

Introduction

“Marijuana Legalization: Beyond Yes or No,” is unquestionably a hot political topic. However, this is not a political paper and I do not take a political position. What I will do instead is give you a policy research perspective and discuss the different levers we could pull, and what their impact might be. The most important lesson of cannabis policy research is that we have many options rather than facing a blanket yes or no decision. We have choices and needn't confine ourselves to picking between a war on marijuana on the one hand, and a clone of the tobacco industry on the other. There are plenty of other cannabis policy options, whether it is legal or illegal, and those options should be left to you as voters.

This paper will first go over some basic terms and concepts, then discuss what's going on in the world around cannabis with a focus on the United States. I will then offer some policy options to consider if New York chooses to legalize recreational cannabis. There are four terms I'm going to discuss throughout this paper that are often used carelessly or incorrectly in the media, and sometimes in academia too. So let me begin by defining decriminalization, legalization, commercialization, and normalization.

Decriminalization

Decriminalization is not the same thing as legalization. It is about the user, the person who smokes pot or consumes the marijuana-filled brownie. Decriminalization is focused on removing criminal penalties for using cannabis and for possessing small quantities of the drug for personal use. There are different varieties of it.

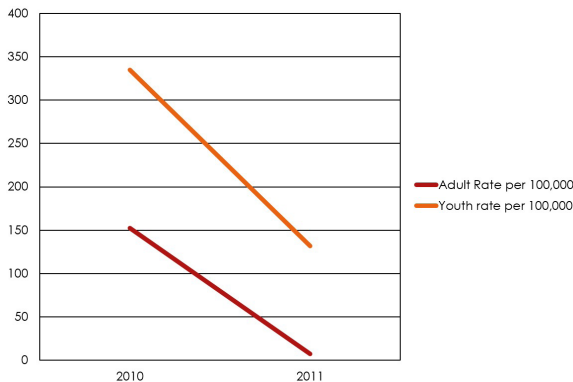
Sometimes there is no arrest, but you still have to pay the equivalent of a parking ticket. Sometimes you have to do a court appearance, but as long as you do it, your record will be waived. However, the general idea is that you are taking away or greatly reducing criminal penalties and the long term costs that can accompany them. For example, having a criminal record can affect someone's ability to get a job, secure housing, or get a student loan. Decriminalization would get rid of that.

What does decriminalization do to drug use?

People often worry if marijuana is decriminalized, then everybody will start using a lot more of the drug. The evidence shows that usage may increase a little, but it is not a huge effect. Some increase in cannabis usage can happen because criminal punishment can be thought of as a cost, even though it's inconsistently applied (i.e., You probably won't have to "pay it", but you can't rule it out). Therefore, once people know there is no chance they will have to pay that cost, there will be at least some people who will say, "Okay, I'd like to try this now that I know I can't get arrested." So, that can increase population cannabis use, but the effect is small. In contrast, the effect of decriminalization on arrests is huge.

Figure 1

Marijuana Possession Arrests in California Collapsed Immediately Following 2010 Decriminalization



The state of California decriminalized cannabis in 2010 both for adults and for young people. You can see the drop in arrests in Figure 1. The graph represents 12 months of data that embodies an 87% drop in arrests in the youth population, as well as in the adult population (Males, 2012). That's almost every single cannabis possession arrest that police used to make in California.

You can see the same thing in other countries as well. In Western Australia, police began issuing Cannabis Expiation Notices, rather than making arrests for cannabis use/possession. Authorities would write you up and say, "You've done this thing," and they would take the cannabis and say, "But, you can avoid any criminal sanction." Researchers evaluated how many of the people who had one contact with the police around cannabis, had contact with the police again, meaning something else bad had happened. It used to be one-third of people would be repeat business and it went to zero (Babor et al., 2018). That is truly taking cannabis users out of contact with the police. There are many social welfare gains from doing that. For example, the police can do other things that many people would argue are more important, and you do not have the arrest damage which can be substantially worse than the use of the pot.

Some people worry about net-widening, which is a concept from criminology roughly stating that if you make the penalty really modest, then police will start applying it more. The idea is that before decriminalization, police officers would say, "Well, it's just a joint. I don't want to give the person a criminal record." But when the penalty changes to being just a ticket, they say, "Well, if it's just a ticket, I'll do it." This has happened in some locations after decriminalization, but it does not seem to be a big effect or the norm. So we are pretty safe in concluding that decriminalization wipes out almost every cannabis possession arrest and reduces police interaction with users.

Lourie Lecture Policy Brief

To summarize, decriminalization certainly cuts arrests if they were prevalent to begin with. Clearly, if the police had long ago stopped making cannabis possession arrests (which happens in some locations), formally ratifying the de facto policy in a decriminalization law won't reduce arrests because they aren't happening anyway. But assuming police were making a lot of possession arrests, decriminalization will dramatically cut them back to nothing or nearly nothing. The policy thus presents a value judgement for voters: would they accept a bit more cannabis use and a lot fewer cannabis arrests. Whether that's a good trade or not is a political question and not a scientific one.

The reason cannabis usage does not change much under decriminalization is because of what Peter Reuter, a drug policy analyst, describes as structural consequences of illegality for the industry (Reuter, 1983). When growing, promoting, and selling cannabis is illegal, cannabis becomes less accessible and more expensive. Decriminalization maintains those constraints on cannabis producers and sellers. In other words, society can remove penalties on users without creating legal cannabis corporations. You do not have to have full legalization in order to eliminate criminal penalties for cannabis users.

Why Decriminalization and Not Legalization is How Arrests are Reduced

Another thing to note is people often believe that cannabis legalization will reduce arrests. Oddly enough, it generally will not. If you had a state that had an extremely tough marijuana regime and they are arresting people like crazy, and they went straight to legalization, then they would see a big fall in their arrests. But the political reality is, those aren't the states that make the move to legalization. Instead, states that legalize almost always have decriminalized first. By the time legalization starts to appear as

a viable policy, there just are not that many arrests left because decriminalization has already eliminated them.

Will Decriminalization Reduce Imprisonment?

If you decriminalize, does it empty out the prisons? No. When political candidates say, “I have a plan to get rid of mass incarceration in this country. I’m going to release all the pot smokers from prison,” my reaction is, “Really, both of them? Thanks for taking a bold stand in life!” People do not go to prison for smoking pot. Even if you take the broadest definition of a marijuana offense and include people who had 500 pounds of marijuana, a gun, and were evading taxes when they were caught, it still only adds up to 1% or 2% of the American prison population (Caulkins et al., 2016). Maybe you still want to release those people. That is an interesting debate to have; however, fundamentally, you are leaving 98% to 99% of the prison population on the table. That being said, changing cannabis policy, contrary to what some have promised, is not going to alter the fact that we have nearly 1.5 million human beings in state and federal prison (Bronson & Carson, 2019).

Legalization

Legalization goes beyond decriminalization by saying not only that it’s okay to use and possess cannabis for personal use, but also that people can grow large amounts of it and also sell it. When cannabis production and supply become legal, it does something decriminalization does not: create competition for a black market. If you decriminalize, people are still buying from criminals. If you legalize, the black market should – at least in the long term - shrivel because legalization can provide a cheaper product that people can buy and sell without any risk of arrest. As a result, criminal sellers should go out of business, as did bootleggers when alcohol prohibition ended (Cook, 2007). The other effects of legalization depend enormously on how it’s designed, which is why it’s vital to through all the policy options available.

Figure 2

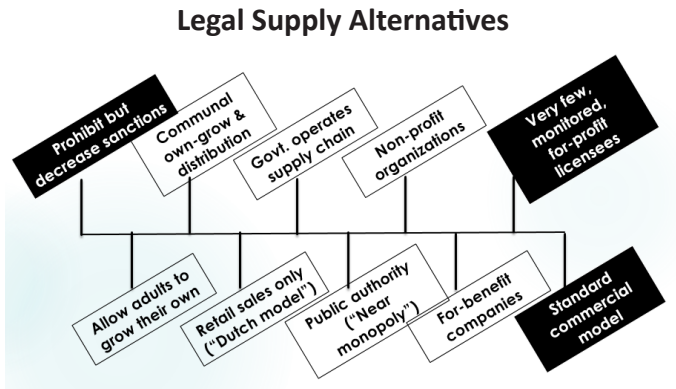


Figure 2 is adapted from the RAND Corporation team, which is led by Jonathan Caulkins and Beau Kilmer. The figure presents a range of alternatives for handling the supply part of cannabis policy (Caulkins et al., 2015). The options range from saying, “Well, we aren’t legalizing supply and production but we’re going to lower the penalties,” to the other end of the continuum which is, “We’re going to have another big tobacco; we’re going to have a whole private sector free-for-all.” However, there are many options in between. You could say, “We’ll let people grow their own, so everyone is a legal producer”, or “We’ll just let adults grow it”, or “We’ll have clubs that grow it like Spain does.” Or you could adopt the Dutch model which has cafes where you can legally sell, purchase, and use cannabis, but you cannot consume it other places.

You could also have “state stores” as the only legal sellers. If you are old enough and you grew up in the right part of the country, you will remember that state governments used to run liquor stores after Prohibition. In those states, the state stores advertised less, they carded more consistently, and there was less drinking. You could employ that as a model for cannabis legalization. Yet

another possible model is to have public benefit companies which sell cannabis but are non-profit. Alternatively, if legalization allows private sales, the policy could license very strictly or versus loosely. In short, there is a huge range of options here. One of the things I think that has been bad about our polarized political debate is that mainly what we have been presented with is just the standard commercial model. In other words, voters are asked to pick between lots of people being arrested or having tobacco-style cannabis corporations, which is a false choice. We have a lot more flexibility than that.

Commercialization

Commercialization is a process that legalization makes possible, but is distinct. Commercialization is when you bring in modern marketing, advertising, profit-seeking, and heavy promotion. There is good evidence that this has unique effects different from legalizing a business per se. I can show you that by talking about the Dutch. The Dutch do things very carefully. They gather data and then they pragmatically say, "Let's switch this and switch that." There is all this great data on cannabis from them, and they have been working on this for decades. The Dutch had an experiment to set up cannabis cafes. When they set up the cafes, some people said, "Everyone's going to be high all the time." However, very little evidence showed that setting up these designated spots where you could legally consume cannabis changed consumption that much (MacCoun, 2011). It turned out that it was not that big of a deal. However, over time that industry evolved and they opened up more cafes and started advertising, including in other countries, and having two-for-one sales, and all the things we associate with modern commerce. It was then that Dutch consumption tripled in a period where nowhere else in Europe changed. So, the Dutch, being Dutch, said, "Well, we don't like that," so they crimped down on the commercialization aspects, while still keeping the cafes, and showed that use went back down. Now the Dutch rate of cannabis

Lourie Lecture Policy Brief

use is unremarkable; it looks like any other European country. This was documented by my colleague at Stanford, Rob MacCoun (MacCoun, 2011). I believe that is as close you can get to an experiment. Taking away the criminal sanctions for cannabis sales and production is one thing; unleashing the full force of capitalism on a drug is another. However, you do not have to do that in order to legalize, the Dutch have shown that there are alternative ways.

Normalization

Normalization is a process that is not specified in policy but is shaped by policy. Just imagine if I walked into this room and my necktie was wrapped over my face instead of hanging down in the normal way. As I said, "It's great to see you all. I'm really happy to be here in Syracuse," you wonder, "God, how did we get such a weirdo for a speaker?," even though it's perfectly legal to wear a necktie over one's face. I would look at your negative non-verbal reactions and put my tie back down because I do not want to be considered a weirdo.

This is a silly example, but it's relevant because a huge amount of our conduct around substances has less to do with laws than it does what is considered normal in our social space. If this were 1950, we would all be smoking cigarettes. Now, it is illegal, but even if it were not illegal, lighting up a cigarette in public, lots of places people will look at you like, "Ew, gross, cigarettes." Or another one you may remember if you're my age is how people feel about drunk driving. People in the 1950s made jokes about drunk driving: it was no big deal. Now, if you are wobbling out of a party drunk and say, "I'm going to have one more for the road," everyone looks at you as if you are a pariah. Those things affect us a lot because we are far more in contact with other people than we are with the formal forces of law. So what happens if beyond becoming legal, cannabis becomes normalized? What happens if it becomes a banal thing, as common as someone saying, "I'd like a beer," to have cannabis

openly displayed in my home or in my office? That would probably have effects of its own as well. Part of that will be on how people interpret what cannabis means in their lives and what a cannabis problem is.

Below is a story about a woman and her son. This comes from a combination of some people and it is all anonymized so no one's privacy is violated. Imagine this situation:

“Sally is a 40-year-old accountant who is recently divorced. Her 16-year-old son Richard has seemed sad and low on energy since the marital breakup. Richard smokes marijuana every day, both before and after school. He has trouble sleeping and has also gained a large amount of weight. Both his friendships and his grades have deteriorated”

If you're Sally, the parent, you want to know what's wrong with your child. There is a lot going on in Richard's life and it is somewhat arbitrary which problem is considered the “real” problem. In the perfect world of randomized clinical trials, people only have one problem and everyone with multiple problems is excluded from enrolling. However, in real life these things are all mixed up. Therefore, judgements about what is wrong with Richard is going to depend in part on what is normalized, who Sally talks to, and what they say. Let's say it's the late 1980s, the height of the American anti-marijuana era, and Sally talks to her neighbor. The neighbor might say, “I'm hearing marijuana is really bad. Richard has a marijuana problem. You need to get him into addiction treatment. That's why he's depressed, that's why he's gaining weight, and that's why he doing badly in school.” However, if cannabis use were totally normalized, then the neighbor probably wouldn't say that. They might say things like, “Well, you know, it's tough to deal with divorce, that's all,” or, “Kids go through these phases. It's nothing,” or, “He's got an eating disorder,” or, “Maybe he needs a tutor and needs to learn how to study better.”

Lourie Lecture Policy Brief

Any of these analyses of Richard's problem may be true or false. We do not know which his problem truly is. However, the point is just that. Whether we fully normalize and we come to think that using cannabis is banal, it will change how many people think about their problems and whether or not they seek help. Sometimes that will be good because the problem isn't the cannabis, and sometimes that will be bad because the problem is the cannabis. The force of normalization is wrapped up in many other political and economic forces, for example it's absolutely clear that corporate industries try to normalize use of their products. But they aren't the only player – all of us have some power to shape the social norms around substance use in the circles in which we move.

Global Developments

So what's going on out there on this wild planet of ours? Well, I have mentioned the Netherlands. They are still experimenting and trying different things. They have recently decided that you have to have a Dutch passport to get cannabis out of cafés near the border, like in the city of Maastricht. Spain has membership clubs that you can use cannabis in legally. Uruguay has legalized cannabis use and they sell it through a pharmacy system. Canada has legalized, with the provinces allowed to have a fair amount of latitude of how they want to design it, which I believe are going to range from free market to a state monopoly model.

Then, there is the United States. The remainder of this paper will talk about us, because that is where we have the most data. American exceptionalism gets a bad name as a concept but sometimes, it is warranted. We do seem to be different from any other country in the amount of freedom we give corporations to do what it is they'd like to do. That likely means that our form of legalization will be different from what you would see in other countries. Therefore, we need to keep that in mind and not say we have to yield to that automatically, but just assume that potentially what we do is not

going to generalize to other countries and what other countries do may not generalize to what we do.

Right now almost all the good outcome data that we have is from the U.S., with some exceptions. What is being done ranges from for profit free-for-alls to better regulated systems. Eleven states and the District of Columbia have legal recreational marijuana right now. Other states have medical marijuana that is so loosely regulated that it is almost de facto legalization of recreational marijuana. This was true in some of the legalization states (e.g., Washington & California) before they formally legalized. It was easy to get access for almost any reason and use as much as you wanted. Cannabis is still federally illegal which creates some very awkward situations in legalizing states. Everything that is going on now in the “legal” marijuana industry is a federal felony, but the federal government is not doing anything about it. This raises challenging questions about interstate commerce and banking and other areas overseen by the federal government. However, those state-federal contradictions are just the way it is, at least for the moment.

Most legalization in the U.S. is on a private for-profit model. Vermont and Washington, D.C. are exceptions, although they are both under threat. There you can grow it, you can use it, you can possess it, you can give it away, but you can't run a business by selling it. The longer-term trends in the U.S. are decriminalization and normalization. If you look at how much people are smoking marijuana, you will see it has roughly doubled the volume of consumption in the last 10 years or so. Yet the amount of arrests per use have gone down quite a bit. More generally, even outside the states you are seeing a move away from enforcement against this drug.

Public Health Impact

What is going to be the public health impact of legalization? I'm going to discuss seven things: (1) What happens to prices and why they collapse. (2) What does that mean for taxes? (3) What

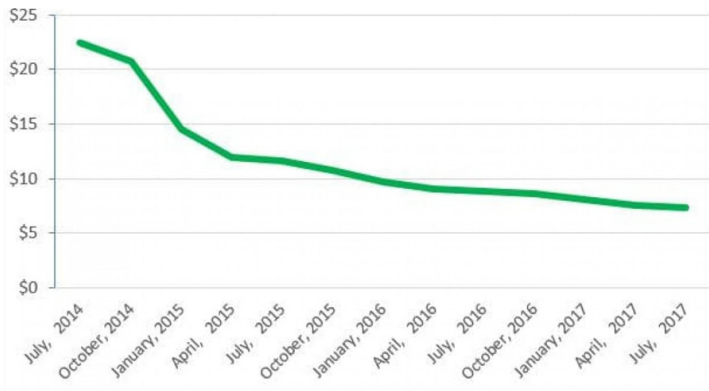
Lourie Lecture Policy Brief

does that mean for revenue? (4) Where we are with potency of the drug. (5) What's going on with people who are heavy users, meaning they use every single day or almost every single day. (6) Will cannabis legalization change use of other substances? (7) And then last, will legalization mean that more people come in to seek cannabis treatment or not?

The most economic important thing to know about legalization is that it causes a price collapse. A word like decline or drop does not do it justice. It is a collapse. As fast as 2% per month (Humphreys, 2017). Cannabis is easy to grow. Indeed, it can grow in a whole range of climates without any help from us, which is why we call it weed, right? Yet under Prohibition, it sells for the price of a precious metal. How could that possibly be the case? Well, as soon as you take away Prohibition, you see this extreme drop in price. Figure 3 displays Washington State data that I published in The Washington Post in 2017. It has gone down since. This is data per gram (Humphreys, 2017).

Figure 3

Retail Price Per Gram of Legal Marijuana in Washington State



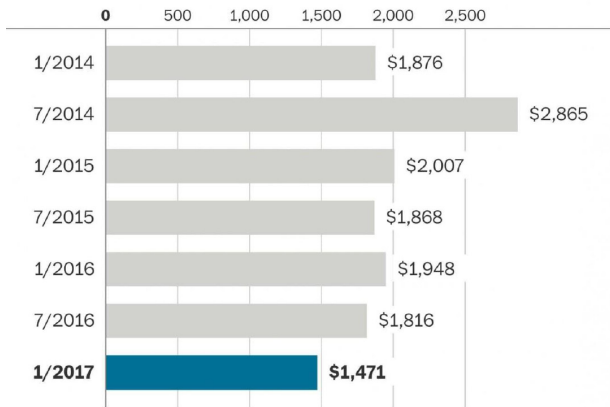
Source: Washington State Liquor and Cannabis Board data assembled by Steven Davenport.

(Humphreys, 2017)

Figure 4 is wholesale prices in Colorado through January of 2017. Prices are down another third since the end of the time series data in the chart (Humphreys, 2017). And these are just going to continue to fall. So this is hugely important for multiple reasons.

Figure 4

Wholesale Price Per Pound of Marijuana in Colorado, 2014-2017



(Humphreys, 2017)

How low could it go? Much lower. The leading drug policy analyst Jonathan Caulkins (2019) points out that cannabis yields about one thousand pounds per acre. So you think, what does it cost, what is the production cost for an acre of typical agriculture? Well, if you look at tomatoes, it is about \$10,000 per acre. If we use the calculation to convert that, then we can probably produce cannabis for a couple pennies per gram. Americans roll their joints at about .4 grams per joint, so that means a joint would be roughly two to three cents. Caulkins makes the analogy that it could be like the beer nuts they leave for you at the bar, something they do not even charge for (Caulkins, 2019). Or the chocolates they put on your pillow. And we're down to actually \$10 per gram or now \$9 per

Lourie Lecture Policy Brief

gram, so there's still a long way, a long, long way to fall. It is possible that prices are going to fall again. They have already fallen 60%, 70%, 80%, 90%. They could easily fall another 60%, 70%, 80%, 90%.

Why Marijuana Prices Collapse

Why are marijuana prices collapsing? There are a couple of different reasons. We will start with a scenario about work. Let's say you are a student at Syracuse University and you're looking for a summer job. I run a furniture store in downtown Syracuse, and say, "Yeah, I want to hire you. All you have to do is stand in the showroom, and when people come in, you tell them about the furniture. If they like the furniture, you sell it to them. What do you think a fair wage is? \$14 an hour?" And you say, "Yeah, okay, I'll do it for \$14 an hour." But then I say, "Oh good, I should add a few more details. All the furniture is stolen and you could go to prison for selling it. And there's another furniture store down the street, and that guy doesn't like me, and he has a gun. So you might want to get a gun. And whatever you do, do not call the police." Now how much money do you want to be paid? You are not going to do that for \$14 an hour, if you are even going to do it at all. You will get far fewer people who are willing to participate as labor in illegal markets, and you have to pay them to compensate them for the risk. Illegal markets also endure added costs because they have to operate secretly versus at scale. For example, standing on the street corner, selling crack, in Baltimore, you might only do, 10, 15, or 20 deals a day. However, a clerk in the supermarket can scan that many items in a few seconds, because they can be out in public.

Also, if you're a legal business, you have contract enforcement power from the government, i.e., if someone rips you off, you have access to the courts and the police. You don't have any of that with an illegal business. You can't walk into the police station and say, "I delivered this really top quality heroin and the guy didn't pay me. I want him arrested." Instead, you would say, "I'm going to get a

bunch of guys with guns together and we're going to go try to get our money back." That costs money and involves risk. Finally, legal businesses are also more successful because they have marketing expertise, which makes their product more appealing. They can hire the best minds of Madison Avenue to sell their wares; illegal organizations cannot.

Implications for Taxes and Revenue

The decrease in the price of marijuana has big implications for how states design their taxation. A big reason many people voted for marijuana legalization is not because they cared about legalization per se, but because they thought they were going to get money through tax revenue. Imagine you have a product that's falling in price really fast, and you pass a 20% tax and say, "This tax is going to bring in big bucks because cannabis costs \$400 an ounce. We're going to sell a million ounces a year. We take 20% of that and we're going to build a bunch of highways and schools." Then a year later, it's \$300 an ounce. That's not as much, but we'll still be okay. Now it's \$200 an ounce. Then it's \$100 an ounce. Then maybe it goes down to nothing. Then you are left saying, "Well, if somebody buys two joints, we put a penny tax on that and we'll do something with that penny." So your tax revenue chases prices down to the bottom.

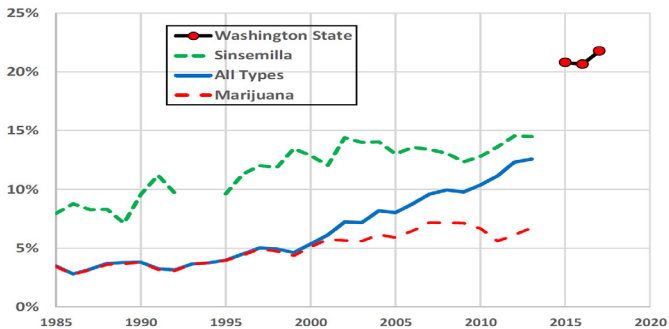
Ad valorem taxation brings in significant revenue only if the price doesn't collapse. This happened in Colorado. They raised their percentage tax rate on cannabis and in 12 months, the decline in the price of cannabis market canceled out all the added revenue. The way to handle this is to tax in different ways. You can tax based on weight, e.g. \$75 per ounce. Another way to do it is to say, "We don't want marijuana to sell for a penny a joint. We are going to say the minimum price a legal merchant is allowed to charge is a dollar a joint," or something along those lines, which both reduces use, but also then gives you more tax revenue.

Cannabis Potency

The downside of taxing cannabis by weight is potentially on the potency side. If I'm going to be charged per unit of weight, maybe I just try to grow 80% Tetrahydrocannabinol (THC) product all the time. You have to think about then also adding something that would discourage people from doing high potency, and there's different ways to do that. Let me talk more about potency in general. Marijuana is a lot more potent than it used to be. According to data on the first 30 million sales in Washington State shown in Figure 5, the average THC potency of cannabis sold is about 20 % (Smart et al., 2017). THC is the principal intoxicant in the drug. Depending on how old you are, you may have a perception of cannabis that is different from what the current products are. If you used it in the 70s or the 80s, you almost surely used a much lower potency drug. There are some products that go way higher than 20%, all the way to 60%, 70%, 80%, or 90%. We do not actually know what they do. However, there is some potential risk here. Just as you would be more worried if you caught your child with a bottle of vodka than a bottle of beer, you might more rationally worried about a product that is 20% versus 4% or 3%.

Figure 5

Potency has Risen Sharply



(Caulkins, 2019)

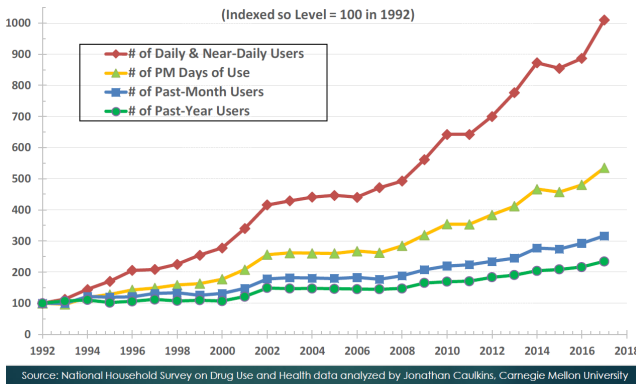
Between 1995-2014, the average THC content has tripled, and Cannabidiol (CBD), which is another component of the plant, has halved. That is likely worrisome because it's not definite, but it's possible that CBD can temper some of the potential negative effects of THC.

The Increase in Daily Marijuana Use

How people are using the drug is becoming a bit worrisome. More people are smoking cannabis now since legalization, but not a lot more. What's driving the increase in the volume of consumption is really heavy use. So it's not that there are vastly more people smoking cannabis once a week, it's that there's a lot more people who used to smoke it once a week who are now smoking it every day (Caulkins, 2019). This may be connected to falling prices and increasing potency. You can see Caulkins' analysis of these data in Figure 6.

Figure 6

Growth in Marijuana Use Reported in U.S. Household Survey



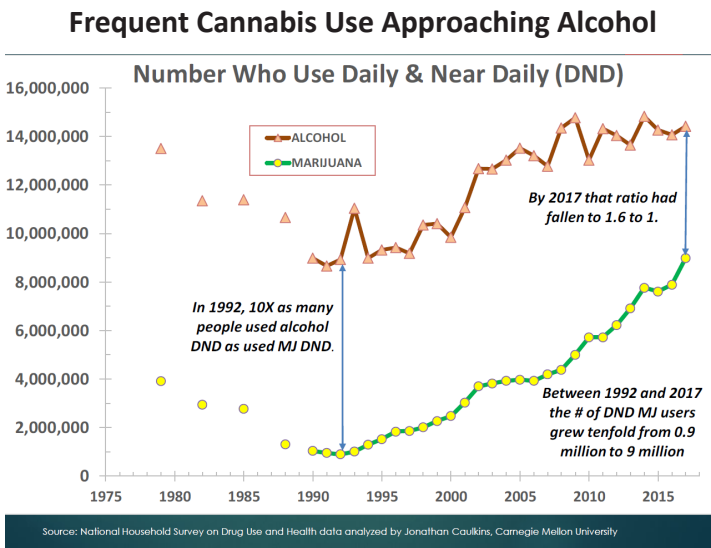
The green line represents how many people have used it in the last year, over a very long period. It's gone up a little, as expected. It's approximately twice as high as it was during it's historical low point.

Lourie Lecture Policy Brief

Most people wouldn't be hugely concerned about that. On the other hand, people who use all day or nearly every day has gone up tenfold. Those users were a much smaller part of the cannabis-using population in the past (Caulkins, 2019).

Figure 7 is from Jonathan Caulkins comparing people who drink every day versus people who use cannabis every day. The ratio between those two used to be 10 to 1, and now it's almost even, as many people using cannabis every day tend to use alcohol every day. We know that for most drugs, if you use them a lot more, you are at higher risk of enduring some kind of harm (Caulkins, 2019).

Figure 7



If you go back 30 years, a typical cannabis user might have one joint on a weekend night; we'll say 4% THC was the typical strength of a joint then. That works out to consuming an average of 4.6 milligrams of THC a day. But if you have somebody who's in the legal Washington market today and they're a daily, near daily users, they're consuming 300 milligrams of THC per day. That is more than

60 times as much. That is the same difference between chewing a coca leaf off the plant in Colombia and using cocaine, i.e., it is a big change. Additionally, that means much of what we know about the effects of cannabis is probably wrong because it's based on these older, weaker cannabis which people didn't use as much. So, if there's more harm here, we would not necessarily know it yet. We will find out if people have problems in the future.

Increased Cannabis use and Effects on Alcohol and Opioid Related Harm

If there are increases in cannabis-related harm, maybe they will be traded off by reductions in problems with other substances. If cannabis legalization led to a doubling of cannabis use but alcohol use dropped by a quarter, we would likely be ahead because alcohol is so criminogenic. As a result, we would have less violence and we'd have fewer car accidents. People might say, "That's a good trade. I'll sign up for it." Is that true?

There are a few ecological studies showing that in geographic areas where medical cannabis has been legalized, the alcohol consumption is lower than expected and opioid overdoses are less prevalent than expected (Baggio et al., 2018). Theodore Caputi has written a smart critique noting how improbable the claims of these studies are (Caputi, 2019). For example, he notes a study claiming that medical cannabis reduced population alcohol consumption by 15%. Fifteen percent of U.S. alcohol consumption is almost 100 million gallons of pure ethanol, which is 205 billion standard drinks. About 2.5% of Americans use medical cannabis, meaning that the study is concluding that 2.5% of Americans have collectively reduced their annual drinking by over 200 billion per year. The average user of medical cannabis would have to cut their alcohol consumption by 3,000 drinks a year for this to be true. For any one of them who did not drink to begin with, someone out there needs to cut their drinking by 6,000 drinks a year. Caputi's critique is pretty

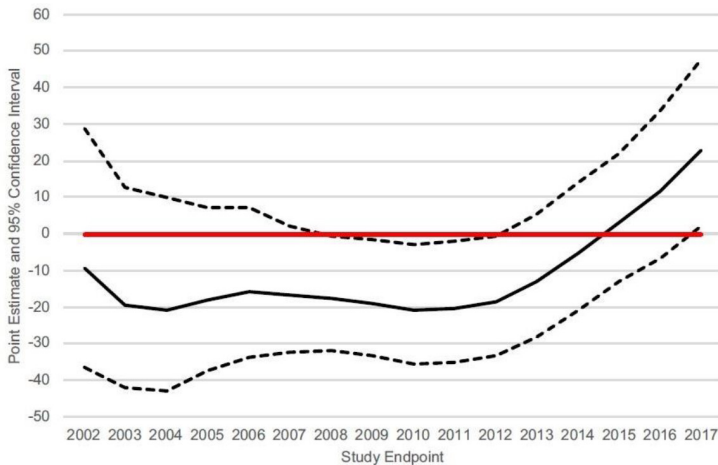
Lourie Lecture Policy Brief

devastating for many of the studies claiming substitution effects of cannabis legalization. It is still theoretically possible that there could be substitution effects, but it's hazardous to take aggregated correlational state-level studies at face value.

The other hope is that cannabis use could reverse the opioid epidemic. This is a very common headline. Our group just tried to replicate these results using more data. Figure 8 is from our paper, led by Chelsea Shover, and published in the Proceedings of the National Academy of Sciences about a month ago (Shover et al., 2019). The states that initially had medical cannabis had lower than expected rates of opioid overdose for a few years, as some studies reported. But when we followed it forward with much more data, the association switches to the other direction. We do not think that means medical cannabis is killing anybody now any more than it was saving anybody a few years ago. Rather, we think this is a textbook spurious association that has been over-hyped.

Figure 8

Much-Touted Negative Correlation between Cannabis Access and Opioid Overdose Deaths has Reversed



(Shover et al., 2019)

Since I'm in New York, I'll go even further. It's a terrible mistake of the New York Medical Board to say that people who are addicted to heroin and are taking an FDA-approved medication, like buprenorphine or methadone, can switch off medication and take medical cannabis (Humphreys & Saitz, 2019). That is extremely dangerous, and I think it is quite disappointing that New York State allows that. In my opinion, that is a shamefully low standard of proof of medical efficacy that we would not accept for any other population other than people who are addicted to drugs.

Another point about correlational findings is that if you are going to believe some of them prove causality, you should have the integrity to believe that of all of them. If you are going to look at early studies that show medical cannabis correlates with fewer opioid overdoses, there are other correlational studies showing positive correlations. People who are in pain and use medical cannabis in addition to opioids use more opioids than those who do not (Degenhardt et al., 2015). In the national population, medical cannabis users have higher rates of prescription drug misuse than non-users (Caputi & Humphreys, 2018). Cannabis use predicts increased likelihood of developing prescription opioid use disorder over time (Olfson et al., 2018). These are all correlational studies. If we are going to deal with correlations, we have to accept the fact that they go in different directions. It is hard for an honest person to say we have proved this causal link when we have the correlations going in opposite directions in multiple studies. You have to cherry-pick pretty aggressively to come to that conclusion.

Right now, we've got a lot of weak, overhyped science saying that cannabis legalization is going to solve the alcohol and opioid problem. There are a lot of corporate interests at play. Weedmaps (an online tool that assists in finding medical and recreational marijuana dispensaries, brands, etc.) took out billboards saying, "This will stop the opioid epidemic. It will save thousands of lives if

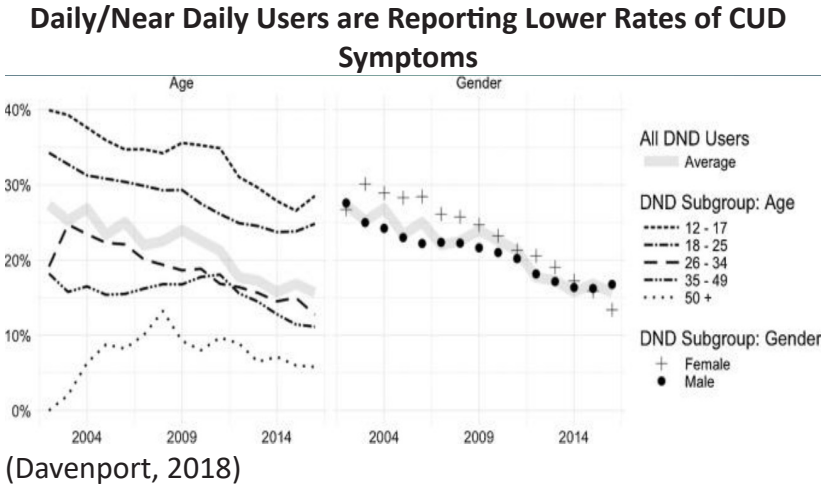
you legalize cannabis,” which incidentally would also make them a lot of money. I think it is important to protect the integrity of science in all this and just call them as we see them, and not steer towards a corporate or ideological interest, but just say what the facts are (Humphreys & Hall, 2019). Protecting the integrity of science and the public perception of scientific work might make us live or die as a species - I really believe that. Climate change is infinitely more of an important problem than cannabis. If we made cannabis one of the four food groups and mandated it's use every day, it would still not be as bad as climate change. A big challenge we have in climate change is that some people do not believe scientists anymore, and ignoring science in the service of cannabis interests will only make that credibility problem worse.

Cannabis Use Disorder Treatment

Will people still seek help for cannabis use disorder (CUD) treatment if the drug is legalized and normalized? Think of that young man and his mom from the story in the beginning of this paper. If marijuana is legalized and normalized, maybe people will think, “Well, cannabis can't harm anyone, so any problem Richard is having couldn't possibly be connected to all the cannabis he uses. He doesn't need any treatment.” But what if Richard actually would benefit from cannabis treatment?

There is an argument that the only reason people ever go to seek cannabis treatment is because the police make them. An individual is arrested with cannabis in their car and the lawyer says, “If you enter treatment, the judge will like it, and you likely won't get punished.” Then you go to treatment, but you don't really buy it is needed. Is that the way we are going to be regarding cannabis use disorder treatment if the whole country legalizes?

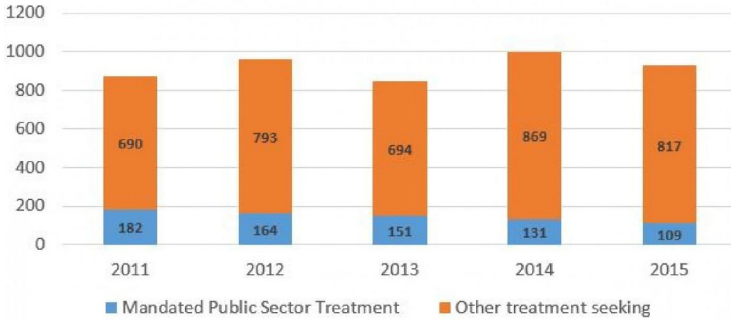
Figure 9



I find the data above in Figure 9 from Steve Davenport particularly interesting. Of this daily/near daily users group, they report lower rates of cannabis use disorder symptoms than they did in prior years (Davenport, 2018). When you ask heavy cannabis users whether they agree that “it’s interfering with my life, it’s causing social problems, causing work problems, I’m having trouble controlling it, I end up using more than I want to,” they are less likely to say yes to those questions today than they were in the past. Now there are multiple ways to explain this. Maybe it is true. Maybe once cannabis becomes legal, you do not endure those legal harms so it is, in fact, objectively less harmful. Or when it’s normalized, your spouse is less likely to criticize you for your heavy cannabis use. Therefore, it is less harmful. Maybe that is true. The other possibility is its just becoming normalized and people are not drawing connections that they objectively should. They are having problems because of their heavy cannabis use, but they think it cannot possibly be that because they have been convinced incorrectly that cannabis cannot cause problems.

Figure 10

Court-Mandated Public Sector and Overall Marijuana Treatment Seeking (in 1000s)

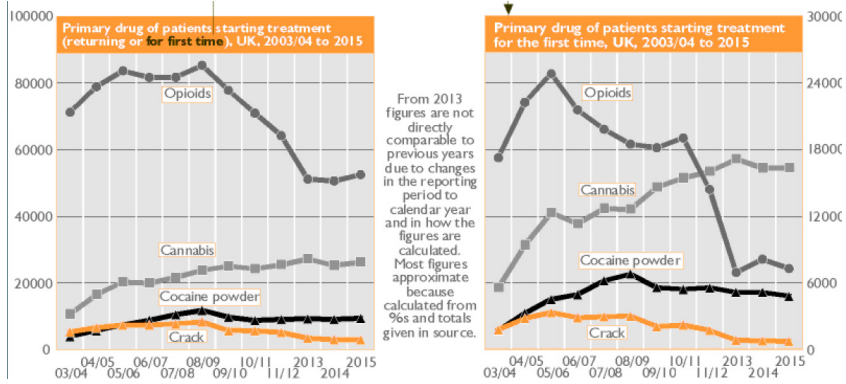


(Humphreys, 2017)

Figure 10 shows treatment data from some work I did for the Washington Post . The blue area shows thousands of people who are forced into treatment by the legal system, and the orange are people who come to treatment otherwise (Humphreys, 2017). As you can see, the court-mandated public sector numbers are shrinking pretty fast. The court systems are directing fewer and fewer people into cannabis use disorder treatment. On the other hand, the rough amount of people seeking treatment overall stayed fairly flat. The only way that could be explained is fewer people are being forced in, but more people are choosing to come in. This is the opposite of what some people would have predicted under legalization, and suggests that more cannabis users are in fact experiencing harm severe enough to led them to choose to seek help.

Figure 11

U.K. also Showing Increase in CUD Treatment Seeking Despite Decreased Pressure



(Ashton, 2017)

Similar findings come from outside the United States. Figure 11 contains British data on why people are coming into treatment. There is little legal pressure to seek cannabis use disorder treatment in the U.K. The chart above displays first-time treatment seekers on the right, and all treatment seekers on the left (Ashton, 2017). Cannabis is the number two reason for seeking help among all treatment seekers, and number one among first-time treatment seekers. They have very potent cannabis in the U.K., and these treatment data could be a sign that it's harming users. On the European continent, the country that has the highest rate of voluntarily seeking treatment for cannabis use is the Netherlands; where there is zero pressure to seek treatment from the legal system (MacCoun, 2011).

Evidence to Consider for New York

Now I will discuss New York. These are some things one could consider if you decide to legalize cannabis. This comes from a paper that I worked on with my postdoctoral fellow, Chelsea Shover. It

Lourie Lecture Policy Brief

will be out soon (Shover & Humphreys, Forthcoming). Let's talk first about what an optimal regulatory structure would look like. You should not have a medical system unless it is, in fact, medical. The kind of faux systems we had in California, which allowed almost anyone to get it for anything, is bad for public health because people attribute medical knowledge and status to the industry, which it does not actually have. There is a recent study where a researcher had women pose as pregnant. They called dispensaries and 69% of them said, "You need to smoke cannabis during your pregnancy" (Dickson et al., 2018). That is not good medical advice. If a doctor did that and then the child had a problem, the doctor would be liable in some way. Unfortunately, the industry is not liable. People who did this in California, which was the first state to have medical cannabis, were very candid. They were doing this to legalize, not because they believed it was fundamentally medicinal. Now, the state has in fact legalized recreational cannabis, so I think we need to go back and say, "Why do we have this? Is it beneficial, is it harmful?"

Some would say, "But there are health benefits to cannabis." There are multiple therapeutic things that come out of the plant, and there will probably be more. However, there are plenty of healthful products that we do not sell through medical dispensaries. For example, if you have chronic urinary tract infections, you might drink cranberry juice because it makes your urine more acidic and that makes you less likely to get the infection. We do not have cranberry juice dispensaries. You buy it in the same stores as people who buy it because they like the taste of cranberry juice. It is not clear that there needs to be the separate system. It is better to put it all together and regulate it like a consumer product, and not give it the medical name, unless in fact it truly is medical. There are some states where it is medical, where you have to have multiple sclerosis or end stage cancer, and then you get it from doctor; that's different. However, these faux medical things are bad.

State Monopolies or Regulating Licensing

I would like people to think about state monopolies. I grew up with what was called an ABC store. There were still private companies that made all the beer, liquor, and wine that you have everywhere else, but you had to buy it at a store that was run by the government. There is a lot of literature on the impact. States that had ABC stores had lower rates of young people drinking and lower rates of vehicular death and drinking. Those stores did fewer promotions and they checked IDs more consistently (Cook, 2007). The government also employed people of color at far higher rates than the private industry. The cannabis industry is very white (Posner, 2018). Therefore, there are a lot of gains, potentially, from doing that. We'd learn a lot if a state or two created state stores where people could legally buy cannabis.

If a state goes the fully commercial route, there are public health benefits to restricting the number of licenses. As with liquor stores, there is some point, both in terms of public health harm but also community amenity, where you can have too many sales outlets. This should be handled through licensing. Make the license hard to get. You can have some licensed outlets so people can buy what they want, but you also do not have 50 of them all in the same street in some neighborhood.

Something commonly said is that we're going to have really loose regulation at the beginning, but we'll tighten it up over time. That's the same as saying that once a U.S. corporation is really powerful and wealthy, regulating it becomes easier. That makes no sense and is exactly backwards. The chance to get in strong regulations are the greatest on the very first day. Ten years from now when you are on the other side of a table in Albany against a billion-dollar industry, your chance of tightening regulations up even modestly are pretty low. It makes much more sense to build strong regulations in at the outset, and then you can loosen up over time if you need to.

Lourie Lecture Policy Brief

You should not count on being able to easily tighten up later; that hasn't been the case with the pharmaceuticals, alcohol, tobacco, or any legal drug.

For-Profit Model

If you have a for-profit industry, the public has an interest in determining how it is overseen rather than trusting it to never put profits over health. There are states where the industry oversight board has the industry on it. If you heard a state say, "We're going to have a tobacco control agency that's going to focus on reducing smoking among kids, and the people on the board are going to be our good friends from Philip Morris." You would say, "Well, that's crazy. That's the fox guarding the henhouse." There is still some of that going on with the design of some of these cannabis regulatory regimes. We need to start to think about the cannabis industry as a corporate, profit-seeking industry like any other. It is not run by gentle hippies wearing tie-dyes, putting a share of profits aside to save the whales. The people running the industry wear business suits and have law and business degrees. They are out to maximize profit and sales not public health or social justice. Some of the biggest investors in it are the tobacco and the alcohol industry. If you have it in your head that they are going to automatically do the right thing because they are altruistic, anti-materialistic activists, that is not accurate. They are going to be trying to make as much money as possible by generating as much heavy cannabis consumption as they can. Society has a strong interests in regulating them tightly as an industry.

It is going to be important for integrity of science for us to have all the disclosure rules that we have around alcohol, tobacco, and pharmaceutical money, also apply to the cannabis industry. My journal, which I edit for the Americas, Addiction, does this. We treat it like any other industry. It does not mean cannabis industry funded people cannot produce research. However, you have to

disclose this so that readers know that the research was funded by the cannabis industry. The government can help reduce the potential problems of corporate funded research by funding its own research on the harms and benefits of cannabis use.

Restraining Potency

What about different product regulation? I believe we should do something to restrain potency. I do not think there is a strong case to have a 50%, 60%, 70%, or 80% product, and I believe most people would be satisfied with lower-end products. Extremely strong products are implicated in many user panic attacks and emergency room visits. We can regulate cannabis product potency just as we have done with other products. You cannot make 150 proof beer and call it beer. The laws of the state says beer is an alcoholic beverage that is in a certain range. We could do that with cannabis, setting a range for potency of different products.

We should also be honest about how little we know. We have many longitudinal studies of the impact of cannabis, but by definition, if I have a 20-year study on the effect of cannabis, it has to be old, weak strength, cannabis because it started 20 years ago. With most drugs, when you take them a lot more and at much higher potencies, they're worse for you. Therefore, I have concerns about relying on studies of occasional users of weak cannabis. We have to be upfront when we give people health information, i.e., "Just remember, a lot of this is based on a much weaker product than you're consuming right now."

We can also discourage high potency through tax policy. Alcohol is taxed more when it is stronger. As an alternative to a potency cap, policymakers could say that if someone wants to make a really strong product, they're going to endure a tax bite on that product.

The last idea, which some people are pushing, is if it turns out that this THC-CBD ratio proves to be important for health, we could tax

Lourie Lecture Policy Brief

it on that basis. We could say, “If you make a really pure THC, no CBD, we’re going to tax that more than if they’re closer together because we think that’s less harmful.” We need to do some more science to find out if this is, in fact, true.

Manufacturing Limits Could Protect Public Health

We could keep addictive products separate. I have said, “Please do not let them make tobacco-cannabis blended products,” to every state I’ve advised on this, and so far, virtually every state has done that. Think of the amount of trouble someone will go to make a blunt, which is basically carving out a cigar and then filling it with cannabis. If people are willing to do that, that tells you these are two great tastes that go great together. People are willing to work hard to get that combination of drugs. It is very common in Europe to blend them. If you were a company you would say, “Let’s make pre-blended packaged cannabis-tobacco cigarettes.” They may be very popular, but that would be bad for public health. It could bring back tobacco consumption. Reducing tobacco consumption is one of the great successes of public health in my lifetime. Therefore, we keep those things separate so they do not feed each other. Unfortunately, it is going to be difficult because it is roughly the same population. If you look at the economic, educational profile of the population that uses cannabis, it overlaps an awful lot with the population of people who smoke combusted cigarettes.

We could also do things to restrict flavors in products. There are cannabis products that look like kids’ candies and they are full of THC. I do not see any need for us to allow those. Eliminating those products could reduce accidental poisonings. Adults will still be able to use cannabis, even if it’s not in the form of a gummy bear.

There is a news story from The Canadian titled “Cronos CEO: \$1.8 Billion from Big Tobacco is just a Beginning for the Cannabis Industry” (Cherney, 2018). People say, “Will it be like the cannabis or alcohol industry?” Well, at least in Canada, cannabis is probably going to be

a division of those industries. \$1.8 billion from Big Tobacco is just a beginning, and they are very well-poised to do this. They have the land, the technology, the rolling machines, they own the shelf space in all the stores, and they have the advertising expertise and the people on contract. It is very possible that this would be the future. The Big Tobacco would have a cannabis division. Maybe you are okay with that. If so, that is your right. However, my judgment of Big Tobacco is that it has been a health and regulatory disaster, so I view that possible future with dread.

Prevent Price Collapse

Prices of cannabis will come down some, but there is no need to have one-cent joints. Some may say the opposite, but you have to remember that you are going to have a lot more use, specifically a lot more use among younger people. They are the most price sensitive. That is what we learned from taxing tobacco. There are different ways to do that. You could put taxes on cannabis, you can assign a minimum price, you can tax by weight, as I mentioned previously. Nevertheless, I think it is worth it to make sure that it is not as cheap as those free pretzels and nuts in the bar.

Limit Marketing

There is a lot that can be done on marketing. U.S. law all the way up to the Supreme Court treats commercial speech like free speech, and whether one likes it or not, that is the way it is. However, you can still put in limits on marketing towards children. That is well established in law, but it is going to have to be done sophisticatedly. One of the problems is that the average person in Congress is 60 years old, and often thinks protecting kids means TV shows cannot have cannabis ads until nine o'clock. What they often don't realize is that young people don't watch TV by the clock anymore, they watch it on their phones whenever they feel like watching it. We have to be more sophisticated about keeping cannabis ads away from young people because the incentive of the industry, of

Lourie Lecture Policy Brief

course, is to get people to start using them young. Additionally, we might consider a plain packaging requirement, which is being done for tobacco in some places. That would take away many of the incentives for companies to build brands, so I believe it is worth considering.

Public Consumption Policies

We have to make some decision about public consumption. There is more than one way to argue this. For example, secondhand smoke. People have legitimate reason not to want to be exposed to that, but it is far less than tobacco. The typical person who smokes cannabis smokes far fewer joints per day than a tobacco smoker smokes cigarettes a day. However, the secondhand smoke is there.

We know that where kids congregate, having smoke-free zones is good in terms of reducing their likelihood of initiating tobacco. We could say that in those zones you would not be able to smoke cannabis. We may also want to designate locations, like cannabis clubs, where people can smoke, but separate them out from other substances. For example, you can buy the cannabis there but you could not buy alcohol. We might want to test that model to try to keep those habits from feeding each other.

Prevent Impaired Driving

Driving impairment is a big issue that we really do not know what to do with at the moment. We do not know how to measure whether someone is impaired. THC is lipophilic, it sticks around the body much longer, and it's much harder to assess whether someone is, in fact, intoxicated than it is with alcohol. Nonetheless, we should learn everything we can from the experience of drunk driving prevention and also put research dollars into developing a reliable field test for intoxication like we have for alcohol.

Conclusion: Facilitate Rigorous Research

A lot more research is needed. We need to know a lot more about new cannabis. What these new products do has barely been studied. What happens when people use them every day versus occasionally? What happens when a teenager uses them every day when they are in their peak of brain development? What are the health effects of different modes of administration? That is another level of real complexity here. You can smoke it, you can vape it, you can eat it, and you can consume it as a wax or an oil. What are all those different effects? We really do not know. We need to study legalization more in the states. A lot of work has been done, but I think we need to look at different populations of people and how they are affected. Then, we need to examine the substitution question regarding other drug use. As I said, the research now does not support any conclusion. We need better research, such as knowing whether alcohol consumption changed as a result of marijuana usage. My hope is that it would go down, but I guess it would be very important to know if it goes up, too. I hope that is not the case. That's a truly important thing to figure out, whether there's a substitution effect, because there could be massive social welfare consequences one way or the other based on that particular phenomenon.

References

Ashton, M. 2017. "Cannabis is Worth Bothering About." *Drug and Alcohol Findings*.

Babor, Thomas, Jonathan Caulkins, Benedikt Fischer, David Foxcroft, Keith Humphreys, María Elena Medina-Mora, Isidore Obot, Jürgen Rehm, Peter Reuter, Robin Room, Ingeborg Rossow, and John Strang. 2018. "Criminalization and Decriminalization of Drug Possession." *Drug Policy and the Public Good*.

Baggio M., Alberto Chong, and Sungoh Kwon. 2018. "Marijuana and Alcohol Evidence Using Border Analysis and Retail Sales Data." Rochester, NY: *Social Science Research Network*.

Bronson, Jennifer and Elizabeth Ann Carson. 2019. Prisoners in 2017. U.S. Department of Justice. Retrieved October 2019 from <https://www.bjs.gov/content/pub/pdf/p17.pdf>.

Caputi, Theodore. 2019. "Medical Marijuana, Not Miracle Marijuana: Some Well-Publicized studies about Medical Marijuana do not Pass a Reality Check." *Addiction*, 114 (6).

Caputi, Theodore and Keith Humphreys. 2018. "Medical Marijuana Users are more likely to Use Prescription Drugs Medically and Non-Medically." *Journal of Addiction Medicine*, 12: 295-299.

Caulkins, Jonathan. 2019. "Cannabis Legalization." Presentation at Stanford University.

Caulkins, Jonathan, Beau Kilmer, and Mark A. R. Kleiman. 2016. "Marijuana Legalization-What Everyone Needs to Know," Second Edition. New York, NY: *Oxford University Press*.

Caulkins, Jonathan, Beau Kilmer, Mark A. R. Kleiman, Robert J. MacCoun, Gregory Midgette, Pat Oglesby, Rosalie Liccardo Pacula, and Peter Reuter. 2015. "Options and Issues Regarding Marijuana Legalization." RAND Corporation.

Cherney, Max A. 2018. "Cronos CEO: \$1.8 Billion from Big Tobacco is just a Beginning for Cannabis Industry." *MarketWatch*.

Cook, Philip J. 2007. "Paying the tab: The Economics of Alcohol Policy." Princeton, NJ: *Princeton University Press*.

Davenport, Steven. 2018. "Falling Rates of Marijuana Dependence among Heavy Users." *Drug and Alcohol Dependence*, 191: 52-55.

Degenhardt, L., N. Lintzeris, G. Campbell, R. Bruno, M. Cohen, M. Farrell, and W.D. Hall. 2015. "Experience of Adjunctive Cannabis use for Chronic Non-Cancer Pain: Findings from the Pain and Opioids IN Treatment (POINT) Study." *Drug and Alcohol Dependence*, 147: 114-150.

Dickson, Betsy, Chanel Mansfield, Maryam Guiahi, Amanda A. Allshouse, Laura Borgelt, Jeanelle Sheeder, Robert M. Silver, and Torri D. Metz. 2018. "931: Recommendations from Cannabis Dispensaries on First Trimester Marijuana Use." *American Journal of Obstetrics and Gynecology*. 218 (1): S551.

Humphreys, K. and R. Saitz. 2019. "Should Physicians Recommend Cannabis as a Replacement For Opioids?" *JAMA*, 321: 639-640.

Humphreys, Keith and Wayne D. Hall. 2019. "Reducing the Risks of Distortion in Cannabis Research." *Addiction*.

Humphreys, Keith. 2017. "How Legalization Caused the Price of Marijuana to Collapse." *The Washington Post*.

Lourie Lecture Policy Brief

Humphreys, Keith. 2017. "More People are Voluntarily Seeking Help for Marijuana Addiction." *The Washington Post*.

Humphreys, Keith. 2017. "The Mistake Most States Made when Legalizing Marijuana." *The Washington Post*.

MacCoun, Robert J. 2011. "What Can We Learn from the Dutch Cannabis Coffeeshop System?" *Addiction*, 106 (11).

Males, M. 2012. "Reform Cuts Marijuana Possession Arrests 86% in 2012, Upends California Drug Policing." Center on Criminal and Juvenile Justice.

Olfson, M., M.M. Wall, S.M. Liu, and C. Blanco. 2018. Cannabis Use and Risk of Prescription Opioids Use Disorder in the Unites States." *American Journal of Psychiatry*, 175 (1): 47-53.

Posner, Liz. 2018. "The Green Rush is Too White: The Hood Incubator Wants to Reverse the Effects of the War on Drugs by Helping Black and Hispanic Businesspeople Enter the Legal Cannabis Market." *Pacific Standard*.

Reuter, P. (1983). "Disorganized Crime: The Economics of the Visible Hand." Cambridge, MA: *MIT Press*.

Shover, C.L. and Keith Humphreys. Forthcoming. "Six Policy Lessons Relevant to Cannabis Legalization. American." *Journal of Drug and Alcohol Abuse*.

Shover, C. L., C.L. Davis, S. Gordon, and K. Humphreys. 2019. "Association between Medical Cannabis Laws and Opioid Overdose Mortality has Reversed." *Proceedings of the National Academy of Sciences*, 116: 12624 -12626.

Smart, Rosanna, Jonathan Caulkins, Beau Kilmer, S. Davenport, and G. Midgette. 2017. "Variation in Cannabis Potency and Prices in a Newly Legal Market: Evidence from 30 Million Cannabis Sales in Washington State." *Addiction*, 112 (12).