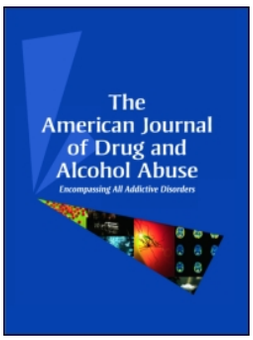

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REVIEW

Six policy lessons relevant to cannabis legalization

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ABSTRACT

Background: Cannabis (marijuana) has been legalized for recreational and/or medicinal use in many US states, despite remaining a Schedule-I drug at the federal level. As legalization regimes are established in multiple countries, public health professionals should leverage decades of knowledge from other policy areas (e.g., alcohol and tobacco regulation) to inform cannabis policy. Objectives: Identify policy lessons from other more established policy areas that can inform cannabis policy in the United States, Canada, and any other nations that legalize recreational cannabis. Methods: Narrative review of policy and public health literature. Results: We identified six key lessons to guide cannabis policy. To avoid the harms of "a medical system only in name," medical cannabis programs should either be regulated like medicine or combined with the recreational market. Capping potency of cannabis products can reduce the harms of the drug, including addiction. Pricing policies that promote public health may include minimum unit pricing or taxation by weight. Protecting science and public health from corporate interest can prevent the scenarios we have seen with soda and tobacco lobbies funding studies to report favorable results about their products. Legalizing states can go beyond reducing possession arrests (which can be accomplished without legalization) by expunging prior criminal records of cannabis-related convictions. Finally, facilitating rigorous research can differentiate truth from positive and negative hype about cannabis' effects. Conclusion: Scientists and policymakers can learn from the successes and failures of alcohol and tobacco policy to regulate cannabis products, thereby mitigating old harms of cannabis prohibition while reducing new harms from legalization.

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Introduction

The normative debate about whether governments should legalize medical and/or recreational cannabis (aka "marijuana") remains high profile and vitriolic in multiple countries, and because of its political nature can at most be only partially informed by science (1). However, a less noticed but equally important discussion occurs beyond the click-worthy headlines and passionate op-eds: Given that medical and recreational cannabis legalization are already a reality in some countries (e.g., Canada, Uruguay) and over half of US states and will likely become a reality in others, what lessons can we draw from other policy areas that will help regulatory systems maximize public health (2,3)? Public health research can and should play a large role in this discussion particularly given the availability of decades of evidence on the impact and regulation of other potentially addictive or otherwise harmful consumables (e.g., alcohol, tobacco, prescription opioids, sodas, nutritional supplements) (4,5).

We write as scientists, policy analysts, and public health professionals, and make no effort in this paper to persuade anyone to vote for or against marijuana legalization. We hope that those who support legalization will find the foregoing discussion of value because they care about public health. After all, no one supports legalization hoping it will lead to more cannabis-induced auto accidents, for example. We hope that those who oppose cannabis legalization will also find our analysis of value because even when the overall policy framework is not to one's liking, there are usually still ways of making it better (or at least less objectionable) including in ways that a legalization opponent would approve. Though many of our examples draw from the U.S. setting, we aim for recommendations that could apply in other countries considering or implementing cannabis legalization.

We recognize that efforts to address public health concerns regarding legal cannabis will meet with some political resistance, particularly in the corporate-friendly United States. Cannabis industry players typically aim to maximize profits even it if harms public health. For their part, voters and advocacy groups often

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care about things other than public health (e.g., their views on personal freedom, their religious and cultural values). But the fact that a public health agenda under cannabis legalization will be difficult to achieve is not a reason to abandon it. Our six lessons are thus explicitly aspirational.

Although we believe the lessons presented here could be applied in many countries, we focus mainly on the United States both because we know it the best and because its cannabis regulation framework is unusually fluid due to the federal-state conflict in law, and the ongoing march of cannabis legalization across state after state (most recently, in November 2018 Michigan legalized recreational marijuana and Utah and Missouri legalized medical marijuana). In the United States, cannabis remains a Schedule I substance and illegal at the federal level, but memos issued during the previous presidential administration effectively left enforcement up to the states (6). A January 2018 memo from the current Department of Justice (DOJ) formally rescinded this policy, and at this writing it remains unclear whether or how the Trump administration will respond to cannabis legalization (7). Further complicating the legal landscape, the cannabis plant contains over 100 different cannabinoids, and there is presently one case where cannabinoids with different properties are subject to different regulations. Medication containing the non-psychoactive cannabidiol (CBD) and no more than 0.1% of the psychoactive constituent tetrahydrocannabinol (THC) were recently down-scheduled to Schedule V (8). All of this complexity, contradiction, and ferment makes it particularly important and opportune in the United States to inject public health concerns into the debate in the hopes of shaping the future.

Do not have a medical marijuana system that is not truly medical

Medicine has status, trust and privilege in society because of what it can accomplish and also because of how tightly it is regulated. Proponents of medical cannabis has attempted to gain similar status, trust and privilege, without the matching responsibilities of being carefully regulated. Indeed, if cannabis is indeed a medical drug, it is the least regulated medical drug in the United States.

The experience of other unregulated quasi-medical industries, for example, the patent medicines that thrived in the 19th century and the supplements hawked on late night cable television, indicate that substantial harm can be done to the public by products that claim medicine's mantle while evading its standards. The lesson for medical cannabis is that public health will be maximized if it either truly functions as medicine (e.g., with specified conditions, specific indications, and tight regulations), or, is folded into the recreational system.

To date, most "medical" cannabis has been sold with almost no medical oversight, with the role of physicians limited to writing a recommendation letter for patients. Physicians do not prescribe cannabis, nor do they provide it. Medical cannabis clients must take the physician recommendation letter to a separate dispensary, which is staffed by "budtenders" who typically do not have medical training. At the dispensary, clients choose from products of varying potency and content. Medical recommendation letters are often provided by physicians at clinics that solely provide medical cannabis recommendations, rather than primary care providers. Because the recommendation letter can sometimes be renewed over the phone or online without speaking to a clinician, medical oversight can easily be limited to the brief initial consultation. "Budtenders" can give any medical advice they wish, and this includes advice that is almost surely harmful to health, for example, encouraging pregnant women to regularly smoke cannabis to reduce cramping (9).

Currently, a number of states operate separate medical and recreational cannabis markets (e.g., Colorado, Maine, Oregon) whereas others have combined the recreational and medical markets (e.g., Washington, California) (10–15). Acknowledging that something that is not regulated as medicine is not the same as medicine as commonly understood is good for public health. Combining programs may also streamline regulation and increase tax benefits to the state by preventing recreational users from entering the more lightly taxed medical system. Additionally, combining programs removes the incentive for youth to seek medical use to avoid higher age limits for recreational sales.

Medical and recreational use overlap, with most people who use medical cannabis also reporting recreational use (16). In a survey of a nationally representative panel of adults, only 10% of those who currently or ever used cannabis used it only for medical reasons (17). By way of comparison, consider how few people who take antibiotics, aspirin, or insulin to manage or cure disease would also use these drugs recreationally. Furthermore, with a few exceptions (e.g., CBD oils), the products available in medical and recreational outlets are the same. There is no reason the public should subsidize recreational drug use by making it tax-free, because lower prices feed over-consumption that harms public health (and also of course, imposes more costs on the public purse).

One concern about combining the two systems is that sick people will have to pay taxes on a medical product.

But many products that can promote health are not tax-exempt (e.g. exercise equipment, cranberry juice for preventing bladder infections, over the counter medications in most states). As therapeutic uses for cannabis are identified with high-quality empirical data, relevant components or resulting medications can enter the medical system like any other drug, proceeding through FDA approval. As cannabinoid-derived drugs are approved, they can be covered by insurance or become available over the counter, where their potency and components will be regulated.

Protect science, regulation, and public health from corporate influence

When many people think of cannabis legalization, they envision a world where cannabis is sold by small operations owned by anti-corporate hippies who donate a portion of their profits to save the whales (18). In reality, legalization in the United States is leading to corporate cannabis run largely by hard-charging white guys in business suits who have MBAs and JDs and think of hippies with distaste if they think of them at all. The tobacco industry has been poised to capitalize on legal cannabis (19), as are the sugary beverage and alcohol industries (20). All scientists are aware of the potentially corrupting influence of industries in funding studies to support preferred conclusions and lobbying to promote industry's business interests. For example, soda companies have long sponsored nutrition studies and legislation (21).

Protecting science and public health from corporate influence could take several forms. Full disclosure of cannabis industry-related conflicts of interest by researchers and journals should be standard (22). Robust noncorporate funding for cannabis research is also important, along the lines of California's Tobacco Related Diseases Research Program, which now funds proposals related to cannabis as well as tobacco.

Advertising regulations like those in place for tobacco products – for example, advertising cannot target children, limits on where and when advertisements can be displayed or aired – may also be a key tool to promote public health. Currently, the industry in the United States complains that its advertising expenses are not tax deductible whereas those of the alcohol and tobacco industry are. The industry's lobbyists are correct that this is an inconsistency, but from a public health viewpoint, the best approach would be to subject alcohol and tobacco to the same restrictions rather than use public funds to subsidize sale of addictive products.

Evidence-informed public health education campaigns about cannabis are needed. Public health messages should take care not to exaggerate risks, lest they lose credibility in the face of the observation that many people do use cannabis without developing a use disorder or experiencing even the harms associated with over-consumption of alcohol. Ad campaigns similar to public health campaigns about alcohol – covering topics like getting help when use is out of control, abstaining during pregnancy and while trying to become pregnant, not using while driving, and not selling to minors – could promote public health.

Public health promoting regulations are more likely to be implemented if policymakers prevent the foxes from guarding the hen house. Multiple states give individuals from marijuana corporations seats on regulatory commissions, and do not require sufficient disclosure of marijuana industry-related conflicts of interest, for example when inviting "independent experts" to comment on developing legislation and regulations. The ballot initiative process is a particularly tempting opportunity to achieve regulatory capture, because industry players can potentially encode pro-profit, anti-public health, rules into the law for the long term. For this reason, even legislature members who oppose marijuana legalization might consider legislating their own framework when facing a corporate-written and funded legalization ballot initiative that seems likely to pass.

Last but most assuredly not least, noncorporate models should be considered by legalizing states and countries, as have been adopted in some Canadian provinces (5,23). For example, the state monopoly system used to sell alcohol in many US states significantly reduces sales to youth and alcohol related harm (24,25). The same should be considered for cannabis, as should restricting the sale to non-profits and coops.

Cap the potency of cannabis products

Some drug policy analysts used to speak of the "Iron Law of Prohibition," which maintained that drugs become more potent over time because they are illegal. This is simply incorrect as tobacco, alcohol, and pharmaceuticals have all become substantially more potent since their development while being legal. Legality per se does nothing to limit potency unless there is a law that caps it.

Just as tobacco became more potent and more addictive in the 1900s – the same has happened with cannabis (26,27). Illegal cannabis smoked on college campuses in the 1970s had 3–5% THC, whereas legal cannabis sold in Washington State today averages 20% THC (28). Higher potency is concerning because of greater risk of adverse psychiatric effects and greater potential light users to

transition to daily users or develop cannabis use disorders (29–31). For example, a study in the Netherlands found first-time drug treatment admissions for cannabis rose following increasing cannabis potency (32). If more potent cannabis is more addictive, increased availability post-legalization may increase the number of individuals who develop cannabis use disorder. Additionally, though cannabis poses essentially no fatal overdose risk, cannabis ingestion poses health threats to children, and this risk increases with increased potency. Increased potency can also magnify the indirect harms of cannabis intoxication, such as impaired driving and accidental injuries.

Because cannabis today has dramatically higher THC levels than in prior era, past research may understate health effects. Capping potency of cannabis products can limit the as yet unknown effects of more potent cannabis while the science can catch up to nature of modern products. Of course, cannabis is not just flowers and leaves: concentrates, oils, dabs, topicals, and products yet to be invented are likely to grow in popularity after legalization. States can mitigate these concerns by capping potency of cannabis products, just as they do certain classes of alcoholic beverages: To call something beer for example, requires abiding by certain limits to ethanol concentration (33). Similarly, cannabis oils or concentrates would reasonably have a higher potency limit per ounce than flowers – just as spirits can have a higher ethanol content than beer – but would still be restricted to a limited amount of THC per package. The limits recommended by California Department of Public Health – which include limiting THC content per package and limiting potency of inhaled products – are a good start (34). For oils and other smokeless cannabis products, the per-package limits would need to be set by regulatory bodies of scientists rather than industry, as discussed earlier. Banning smokeless cannabis products would likely result in increasing use of smoked cannabis and all of the attendant smoke-related health complication. Entirely banning high-potency products legal cannabis market may also have the unintended consequence of pushing consumers to the illicit market (35). Therefore, we do not at the present time advocate banning high-potency cannabis products like dabs, oils, or concentrates, but rather tailored and enforced regulations for labeling and packaging. In addition to capping potency, regulators have the opportunity to reduce harms of co-use of alcohol or tobacco with cannabis by explicitly banning products that combine cannabis and alcohol (as in, cannabinoids in alcohol) or cannabis and nicotine. Requiring every cannabis product sold for smoking or in smokable form to carry the message "Caution; cannabis smoke contains carcinogens" would communicate the risks of smoking specifically that may differ other cannabis products. Finally, regardless of what level of THC cap is in place, governments might consider setting taxes higher for high THC products. We explore other ways to use price setting to promote public health in the next section.

Price may be the most effective lever to promote public health

There's an old saw that "Addicts will do anything to get their fix" but experimental and epidemiological research conducted in dozens of countries has established the opposite: Drug use is responsive to price, even for the heaviest drug users (36).

This observation is critical for understanding cannabis legalization because nothing the government does raises the price of the drug as high as does prohibition, which poses enormous costs on business (37). This is why the removal of cannabis prohibition has produced a price collapse in state after state, including a 70% drop of wholesale prices in 4 years in Colorado and even steeper drops in Oregon and Washington (38,39). Cannabis is called "weed" because it is very easy to grow, and easy to grow, legal crops in America (e.g., wheat) are very cheap. Legal prices are falling about 1% every 2–4 weeks and their natural bottom could be as low as a nickel per joint, such that cannabis becomes like beer nuts – a complimentary offering by restaurants and bars.

Health taxes have effectively reduced consumption of tobacco, alcohol, and sugar-sweetened beverages (36,40). Raising taxes on alcohol has also been demonstrated to reduce serious harms including death and injury due to motor vehicle accidents (41,42).

Sales of retail cannabis have typically been subject to sales and excise tax, but rates vary significantly between states (40). Because these taxes are generally set as a percent of price and the price is rapidly collapsing, the ability of such taxes to raise revenue and deter excessive use is thus waning almost every day (38,39). A more effective alternative is to tax the raw cannabis (i.e., flowers, leaves) by weight as California has always done and Maine has just begun to do (43). This raises fear of potency soaring as producers try to pack more THC in every ounce, but this can be countered by implementing potency caps, as discussed earlier. In the case of products that contain cannabis and other ingredients – for example, brownies, lemonade, and lattes – the amount of cannabis that can be included (in terms of potency) would be set by potency caps, and the tax could be based on the weight or unit of cannabis, not the entire product.

Minimum unit pricing of cannabis also merits serious consideration. This approach is used for alcohol in British Columbia and was also recently implemented in Scotland (44). It is not a tax, but rather a floor price below which a product cannot be sold. Implementing it for alcohol reduces emergency room admissions, alcohol-related arrests and injuries, and deaths (45). Public health benefits would also be expected from implementing such a minimum unit pricing policy for cannabis.

Look beyond reducing marijuana possession arrests

Wanting to reduce marijuana possession arrests is a weak rationale for legalization. Decriminalizing marijuana possession in California for example dropped both adult and adolescent possession arrests by over 60% in just 12 months (46). Arrests can be dramatically curtailed without creating a corporate industry that sells marijuana.

In contrast, legalization is an excellent opportunity to reduce the damage of prior criminal penalties by expunging the records of individuals arrested for possession as well as low-level dealing. This group is disproportionately poor and minority, and their arrest record limits their ability to obtain housing, work, and education (47). It also keeps people with expertise out of the emerging and overwhelmingly white-dominated, cannabis industry.

Currently, the process to get records updated in California requires an individual to hire a lawyer to get a possession record expunged or a felony for selling downgraded to a misdemeanor, but a bill introduced in the state senate would automate this process (48). One way to fund this effort in California as well as in other legalization states would be to designate some tax revenue from retail cannabis sales for this purpose.

Facilitate rigorous research

"More research is needed" has become a tired academic cliché, but it's nonetheless applicable to cannabis legalization. Debate about the health benefits and risks of all manner of products is a commonplace of modern life and is certainly the case with cannabis. In political debates, the drug is characterized as extremely dangerous by some activists and as harmless – indeed extraordinarily therapeutic – by others. There is evidence for some harms and some benefits, although in neither case does the limited evidence available support more extreme assessments in either direction. In terms of benefit, a 2017 report by The National Academies of Sciences, Engineering, and Medicine concluded that there is substantial evidence that cannabis is an effective treatment for some chronic pain conditions in adults, and spasticity symptoms in multiple sclerosis, as well as conclusive evidence of efficacy in treating nausea and vomiting induced by chemotherapy (49). Other reviews have been more cautious in their conclusions, noting that the research base is old, includes many comparisons of cannabis to drugs, which are no longer used because more effective ones have become available, and have small sample sizes (50).

In terms of harms, fairly rigorous quasi-experimental work indicates that greater access to cannabis leads to lower educational achievement (51). US prevalence estimates of cannabis use disorder among people reporting past-year cannabis use vary in recent nationally representative surveys, with estimates ranging from 12% in the 2013 National Survey on Drug Use and Health to 31% in the 2012–13 National Epidemiologic Survey of Alcohol and Related Conditions (29,52). But whether cannabis use disorder is becoming more of less prevalent is not clear (29,52). On the one hand the proportion of cannabis users who used the drug every day or nearly every day is increasing sharply (53), but on the other hand with legalization and normalization, some of the negative effects of frequent cannabis use may be waning (e.g., problems with employers, conflicts with family members who disapprove of cannabis).

The obvious lesson to draw from all other putatively medical products as well as other addictive drugs is that empirical claims about health or social effects and should be investigated empirically. The United States has a careful system for studying and approving medications in place and it should be used for cannabis-related medicines as well. Only through rigorous research can effective therapies derived from cannabis be approved and regulated by the Food and Drug Administration (FDA). Properties should be investigated in controlled studies and resulting therapies should proceed through FDA approval process as have one CBD-derived medication and two medications derived from synthetic cannabinoids (54). It should be noted that the FDA approval process may be particularly difficult for a botanical cannabis product (as opposed to a chemical extract), due to variation in concentration of cannabinoids between plants. However, the FDA currently regulates several plant-matter botanical drug products in its over-the-counter review (e.g., psyllium, cascara, senna) and has approved two botanical products for marketing as prescription drugs (55).

One regulatory reform that has been considered in Congress is to alter the Controlled Substances Act (CSA) such that Schedule I drugs with therapeutic potential could be more easily studied (56). Creating a "Schedule I-R" would allow researchers and regulators to treat cannabis and its addictive constituent tetrahydrocannabinol (THC) as a lower-schedule substance when obtained for the purposes of advancing science (8). The recent downscheduling of a CBD extract formulation (Epidiolex) is an important step, but the rescheduling is currently limited to drugs that have already been approved by the FDA: "As further indicated, any material, compound, mixture, or preparation *other than Epidiolex* that falls within the CSA definition of marijuana set forth in 21 U.S.C. 802 (16), including any non-FDA-approved CBD extract that falls within such definition, remains a schedule I controlled substance under the CSA." (8). Establishing a Schedule I-R would facilitate research on other cannabis products, other cannabinoids, and even other CBD-based formulations, all of which are currently still Schedule I (8).

A second reform that would improve the quantity and quality of cannabis research is to allow more farms to grow cannabis for research purposes rather than having only the federal monopoly provider in Mississippi. It seems bizarre for example that states can operate medical cannabis programs that give the drug to sick patients, but are not allowed to run medical cannabis research programs. In 2016, the Drug Enforcement Agency expanded the number of authorized manufacturers of cannabis for National Institute on Drug Abuse-funded research, but none of the organizations that applied for a license has been granted one by the Trump Administration (54).

For findings to be relevant, and to determine how differing modes of use or potency may modify health effects, at least some research on cannabis must be conducted on consumer cannabis products. Combustible may still be most common mode of use (17), but as retail markets expand researchers need to evaluate edible, vaporized, topical, and other smokeless products.

Currently, one topic that is especially relevant and contentious is whether cannabis legalization can decrease use of opioids. Some evidence suggests that medical cannabis can be opioid sparing (57,58), but studies have been limited by small sample size (e.g., Abrams' clinical trial of 21 patients) or self-reported exposure and outcomes (e.g., Boenkhe's was an online survey of clients of a medical cannabis dispensary). A systematic review found some pre-clinical evidence of "opioid sparing" effects, but clinical evidence was lacking (59). Epidemiological studies show state-level correlations between cannabis legalization and lower opioid overdoses, but such ecological studies have serious, well-known, flaws (60). Even individual-level studies showing that cannabis use and opioid use are positively correlated should not be taken as proof of a causal relationship (61). Yet medical cannabis use is associated with higher rates of prescription drug use and misuse (62). Furthermore, a recent four-year prospective study in Australia found no evidence that cannabis use improved patient outcomes in patients prescribed opioids for chronic, non-cancer pain (63). Clinical trials, and large-scale records-based studies with data at an individual level are warranted.

Change in other non-cannabis substance use after cannabis legalization could also be positive or negative. Some studies suggest that youth smoke cannabis as a precursor to tobacco – this order of events could potentially reverse advances in tobacco control measures (64,65). Broader availability of cannabis could theoretically reduce alcohol-related harms if alcohol and cannabis are substitutes. Conversely, it's possible that legalized cannabis will augment societal harms caused by alcohol use if the two drugs are complements – this line of research needs to be continued. Further research on the relationship between cannabis use and use of tobacco, alcohol, and other substances can clarify this. The urgency of policy research on new cannabis laws should be balanced with the need to gather enough data for careful assessment. There is a risk policy evaluations conducted too soon after cannabis legalization will fail to detect midterm and longer term adverse outcomes.

Conclusions

In summary, cannabis legalization may have positive and negative impacts on public health, and policies should aim to maximize the former and minimize the latter. There are many other important topics we have not covered – for example, public consumption, strategies to reduce and detect impaired driving, rules on pesticides, fraud detection – and the future will likely raise other concerns which no one is aware of at this moment. We recommend continued, rigorous research, by scientists who report results in an objective and balanced manner, free from corporate influence. With the benefit of decades of observation about policy successes and failures in regulating other drugs, policymakers can promote policies that rectify harms of cannabis prohibition, and policies that strive to minimize harms of legalization. Public health professionals and scientists have a role to play in conducting rigorous

research, disseminating results in an objective and balanced manner, and contributing to making evidence-informed policy.

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