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Abstract | More than 20 US states have legalised the medicinal use of marijuana; in the past three years, four have also legalised its recreational use. At the same time, marijuana remains illegal under US federal law.

This paper reviews the US experience to identify any potential lessons or hazards likely to emerge. It outlines the regulatory requirements of different US states for managing medicinal and recreational marijuana use, and the costs and benefits of these measures. It also critically analyses the most common commercial for-profit production and distribution model and examines the implications of this approach in terms of individual, social and criminological outcomes.

Marijuana legalisation in the United States: An Australian perspective

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Marijuana cultivation and distribution is banned by international agreement under the 1961 Single Convention on Narcotics Drugs, now consolidated into the 1988 International Drug Control Conventions (UNODC 2013). The United States of America, with many other nations including Australia, is a signatory to these conventions. Despite this, however, there have been three major movements in the past 25 years that have effectively changed the legal status of marijuana in the United States and made it more widely available.

The first movement, which emerged in the 1980s following the explosion of drug use during the countercultural movements of the 1960s and 1970s, saw the de facto decriminalisation of marijuana use. Imprisonment was replaced with fines or diversion into treatment, as a response to concern about the potentially adverse impacts for young people of acquiring a criminal record for what many argued was relatively minor drug use (Caulkins et al. 2012). The second movement, which emerged in a number of US states in the 1990s, was a push to legalise the use of marijuana for medical use. In 1996, California approved a citizen-initiated referendum to legalise marijuana for medical use, although the definition of medical was very broad. By 2016, 30 US states and the District of Columbia had legislated to allow medical marijuana use in some form. As will be discussed in more detail later, the sometimes very loose definition of what

constitutes the medical use of marijuana, and the varying definitions applied in different jurisdictions, has been a significant driver of ongoing debate and controversy in the USA.

The third major legislative reform movement has been the push to legalise recreational marijuana use and its commercial sale to adults.

Since 2012, eight states—Alaska, California, Colorado, Maine, Massachusetts, Nevada, Oregon and Washington—have voted to legalise recreational marijuana use and the cultivation of marijuana, with the District of Columbia voting to allow adults to grow marijuana for personal use and give it to their friends (Hall & Weier 2015; Caulkins et al. 2015a; Pacula & Kilmer 2014). There have, however, been no legislative changes at the national level; this lack has led to a number of legislative, regulatory and social ambiguities and tensions of the kind that inevitably arise when communities move to address significant social issues in different ways and at different times.

We can also differentiate between *de jure* decriminalisation (that which is the result of changes to the law) and *de facto* decriminalisation (where legislation may prohibit marijuana but the relevant laws are not enforced in practice). As will be described below, marijuana use in the USA is characterised by its *de jure* decriminalisation in many states and *de facto* decriminalisation at the federal level; national laws exist that are not enforced in those states that have legalised marijuana.

The current changes to marijuana legislation in the USA are particularly challenging because they are, for the most part, unprecedented in their nature and scale. As a result, assessing the existing and anticipated impacts of these changes presents unique challenges for policymakers both in the USA and in Australia, as increasing pressure for similar legislative changes must be addressed.

Fortunately for international researchers and policymakers, the United States is also the home to many extremely qualified and experienced social and criminological researchers who are well versed in the science and methods of complex policy impact research. However, as others have observed (Pacula 2014; Macoun 2011), measuring and anticipating the effects of any continually evolving policy reform process that is occurring in a series of highly decentralised settings is not an exact science.

A number of clear lessons are, however, emerging, along with new questions that will require answers. This paper summarises the main findings of many of the US research studies already published and relates these to the Australian context. This is particularly relevant now the Commonwealth has passed the *Narcotic Drugs Amendment Act 2016*, which legalises the cultivation and prescription of medicinal marijuana for therapeutic purposes.

This review examines:

- the range and scope of extant and proposed marijuana legalisation measures in the United States;
- the different jurisdictional models for the use and regulation of various forms of legal marijuana;
- the actual and potential economic, social, health and criminal harms and benefits that have been observed so far or are realistically projected to occur, based on credible studies; and
- possible impacts on supply chains and the roles of those involved in marijuana distribution.

It is important to note that measures for the *de facto* decriminalisation of marijuana use are not the focus of this paper. Such measures are familiar to the Australian experience and are, to a great extent, better developed and more sophisticated in Australia than in the United States (Room et al. 2010).

Rather, the paper focuses on more recent US moves to legalise medical marijuana treatment and recreational marijuana use.

Although cannabis is the standard term used in Australia, the term used in the United States is marijuana. As the United States is the focus of this study, for consistency this paper refers throughout to marijuana.

Marijuana legislation in the United States

US federal law classifies marijuana as a Schedule I Controlled Substance, which means it is illegal under federal law with no currently accepted medical use. As a result it is a federal crime to grow, sell, or possess the drug (US Library of Congress 2014). In addition to facing potential federal criminal prosecution, those who violate the federal *Controlled Substances Act* (CSA) may suffer a number of additional adverse consequences including the confiscation of assets and significant restrictions on usual citizens' rights such as access to banking services, employment, housing, firearms et cetera.

Nevertheless, as has already been noted, a number of states have established medical marijuana services or effectively legalised the use and distribution of marijuana without federal statutory sanction. Under the US Constitution, states are free to make their own laws independent of federal legislation, although the Supremacy Clause elevates federal law over that of the states. In 2005, the US Supreme Court ruled that the federal government had the right to criminalise the production of marijuana even in states where medicinal marijuana had been legalised. Although the right to enforce the federal CSA exists, the government has in recent years made it clear that the production, sale and use of marijuana are not priorities for federal law enforcement agencies. The 2009 Ogden memo, and the subsequent Cole memo in 2011, clarified the position of the US Department of Justice and set out the conditions under which marijuana would be a federal enforcement priority. These largely relate to cases involving juveniles, cross-border trafficking and/or organised crime (Adler 2015).

Some commentators and researchers have suggested the legal and constitutional anomalies that arise from federal–state differences may present potential long-term problems. For example, Kleiman (2014) argues that the complex array of local regulatory measures or, indeed, the lack of appropriate regulation that has resulted from separate states developing their own regulatory regimes may well exacerbate the potential for marijuana-related harm, at the expense of the benefits the measures were intended to deliver. While generally supporting the intention of many of the legislative measures introduced across the United States, Kleiman (2014) cites several areas where this lack of legislative clarity and consequent absence of an effective state and federal co-regulatory regime could produce undesirable outcomes.

A number of the issues that Kleiman (2014) identifies are discussed in more detail below, but it is useful to consider some that are a direct result of the state–federal legislative ambiguity. For example, he notes that marijuana products that are legal in one state may move across borders more easily, and suggests the changes may lead to the rise of a large, politically influential marijuana lobby (similar to the alcohol, tobacco and firearms lobbies). He also notes the absence of nationally consistent controls on advertising and marketing practices.

However it is also important to recognise that some states have attempted to recognise the intention and reach of the federal CSA when drafting legislation to regulate the medical or recreational use of marijuana. What is in question is how successfully these conflicting legislative frameworks have been reconciled.

Medical marijuana legislation

Medical marijuana refers to the use of marijuana and its cannabinoids to treat disease or improve symptoms. Medical marijuana can be administered using a variety of methods, including vaporising or smoking dried buds, eating extracts, taking capsules or using oral sprays. Synthetic cannabinoids are available as prescription drugs in some places (Caukins et al. 2012).

The development of medical marijuana programs in the United States began some time before the introduction of the first specific state legislation to set up formal programs. Shortly after marijuana was listed as a Schedule 1 substance under the CSA in the 1970s, a number of states legislated to allow research into the medical use of marijuana (Pacula, Chiriqui & Terry-McElrath 2002). However, most state legislation was specific to particular research programs and did not include provisions protecting doctors, researchers and patients from penalties. As such, these laws did not really promote the medical use of marijuana (Lynn-Landsman, Livingston & Wagenaar 2012).

The first real medicinal marijuana law, Proposition 215, was enacted in California in 1996 in response to a citizen initiated referendum. Proposition 215 allowed the medical use of marijuana for a broad set of indicators including:

- nausea;
- weight loss;
- pain;
- muscle spasm; and
- any serious medical condition for which marijuana provides relief (Pacula et al. 2002).

By 2016, 30 US states and the Federal District of Columbia had enacted laws that allowed the medical use of marijuana under some conditions. Generally, these laws are predicated on a doctor's recommendation rather than a prescription, and the medicine is dispensed other than through a pharmacy. The fact that marijuana is recommended, rather than prescribed, and made available in dispensaries rather than pharmacies is emblematic of the legal contortions that have been necessary to reconcile the differences between federal and state laws. Doctors are only able to prescribe drugs sanctioned by the US Food and Drug Administration (FDA) and, as marijuana is a prohibited substance under the CSA, it is not certified for use by the FDA. Doctors are also able to recommend marijuana under a US Supreme Court ruling that allowed recommendations under the First Amendment right to free speech.

Around half the states that have enacted medical marijuana legislation subsequently set up systems that allowed dispensaries to sell marijuana to those in possession of a doctor's recommendation. It has been suggested that the growth of for-profit dispensaries in California and Colorado during the 2000s led those jurisdictions to legalise the commercial supply of marijuana (Hall & Weier 2015).

However, while the principle of a doctor's recommendation for medical marijuana use is common to all jurisdictions, some states limit the scope of the term by statute or regulation. For example, in many jurisdictions a patient may possess no more than three ounces (85g) of marijuana for medical reasons. Furthermore, medical marijuana statutes do not ordinarily allow patients to use marijuana in public (US Library of Congress 2014).

Both patients and caregivers are often required to provide their registry or identification cards (Lynn-Landsman, Livingston and Wagenaar 2013), and several states allow marijuana to be cultivated by the patient or caregiver exclusively for personal use (US Library of Congress 2014).

All of this illustrates the significant variation in the scope and nature of medical marijuana laws between states of the United States. For example, one often-cited study, published 12 years after California's medical marijuana laws were introduced, suggested that less than 50 percent of medical marijuana users in that state would qualify for a program in any other state (O'Connell & Bou-Matar 2007). However, reviews by other researchers show that where qualification criteria are stronger and more strictly governed by closer regulation, the number of 'false' participants is much lower (Caulkins, Hawken, Kilmer & Kleiman 2012).

Recreational marijuana use legislation

The recreational marijuana use legislation enacted in the United States so far has sometimes been referred to as 'retail marijuana' legislation. This is because the main provisions of the legislative reforms in two of the early US states to implement recreational marijuana use—that is, Colorado and Washington—focused on removing the prohibition on the cultivation and sale of marijuana (US Library of Congress 2014). The approaches adopted in Washington and Colorado have also been described as the "alcohol model" (Caulkins et al. 2015; Hall & Weier 2015), because the regulatory framework is closely related to the approach taken to controlling the distribution, sale and consumption of alcohol—so much so that Washington State Law is managed by the State Liquor Control Board (US Library of Congress 2014).

However, as is pointed out by Caulkins et al. (2015a), this is just one of a dozen major models for regulating the recreational use of marijuana. For example, the Colorado and Washington models are generally described as for-profit commercial models (Caulkins et al 2015a). As explained by Caulkins et al. (2015a), these 12 supply alternatives break down into three major groups. The two options most commonly discussed in the United States are to:

- retain prohibition but decrease sanctions; and
- implement a commercial supply model, like that for alcohol.

There are eight other middle-ground options, some of which have been implemented elsewhere in the world:

- allowing adults to grow their own marijuana;
- allowing distribution within small co-ops or buyers clubs;
- permitting locally controlled retail sales without legalising commercial production (the Dutch coffee-shop model);
- having the government operate the supply chain (a government monopoly);
- having a public authority operate the supply chain;
- permitting only non-profit organisations to sell marijuana;
- permitting only for-benefit companies to sell marijuana; or
- licencing a small number of closely monitored for-profit licensees.

Finally, Caulkins et al. describe what they characterise as the two extreme options:

- increasing sanctions; and
- repealing the state's prohibition without creating any new, product-specific regulations.

Each of these approaches raises a number of questions that must be answered if they are to be effectively implemented. Further, the answers will depend very heavily on the social, cultural and political context in which the specific models are to be applied—or, as Pawson and Tilley (1997) so succinctly put it, the outcome is a function of the mechanism and its context.

The major changes in the US so far have been to move from the depenalisation model (of retaining prohibition but decreasing sanctions) to implementing an alcohol-style commercial supply model. As explained by Hall and Weiner (2015: 611), since 2012 Colorado regulations have allowed adults over the age of 21 to purchase up to 28.5g of marijuana from any supplier; this limit is nominal because there is no register of sales. The regulations allow the vertical integration of a limited number of producers, processors and sellers. Most of those licensed to grow and sell marijuana for recreational use had been involved in supplying medical marijuana. Marijuana products are taxed by weight rather than THC content, with a 15 percent tax imposed at production and another 10 percent at point-of-sale. Medical marijuana is tax-exempt; home cultivation for personal use is allowed and untaxed. Driving while drug-impaired is prohibited, and state law defines this as driving with five nanograms/mL or more of THC in the blood (Pardo 2014).

The Washington State legislation and associated regulations are more specific than the Colorado legislation. They allow those aged over 21 years to purchase up to 28.5g per store, without any register of purchasers. Producers, processors, and sellers must be licensed, and vertical integration is not allowed. Marijuana is taxed on weight, with a 25 percent tax imposed at production, another 15 percent from production to retailer, and a further 10 percent on sales. The use of medical marijuana will be allowed to continue under existing laws, but home cultivation will not be allowed. Drug-impaired driving is also prohibited; drug impairment is defined as five nanograms/mL of blood (Hall & Weiner 2015; US Library of Congress 2014).

The states of Alaska and Oregon are also modelling their implementations and regulatory frameworks on the commercial models of Colorado and Washington State, which are in turn based on the model for regulating the supply of alcohol (Caulkins et al. 2015). In the four states that legalised marijuana in November 2016 (California, Nevada, Maine and Massachusetts) the regulatory regimes are still being developed, with retail sales likely to commence in 2018.

The regulatory process

As noted, the dominant framework for the regulation of recreational marijuana use is the alcohol-style commercial supply (or for-profit commercial) model. Medicinal marijuana use regimes are more closely aligned with conventional medicinal pharmaceutical frameworks, although recognising there are significant differences to pharmaceutical regulation (in terms of dosage instructions, side-effects warnings, the labelling of ingredients and so on) (US Library of Congress 2014). However, both models rely on commercial manufacture and supply. There are significant implications and risks associated with regulating the commercial manufacture and supply of marijuana, as the history of misuse and abuse within both pharmaceutical drug manufacture and supply regimes and the management of products like alcohol and tobacco can attest.

The misuse, over-prescription and diversion of medically supplied drugs is a perennial and ongoing problem worldwide. Part of the problem lies with differences in availability between different jurisdictions, as well as the differing classifications of some substances as controlled and prescription only. This creates potential opportunities for black and grey markets to develop or be exploited as well as incentives for a range of corrupt practices associated with distribution and supply.

For example, in a recent small-scale study of medical marijuana diversion among a sample of adolescents aged 15–19 years in Denver, Colorado, 48.8 percent reported ever obtaining marijuana from someone with a medical marijuana license (Thurstone, Lieberman & Schiege 2011). This study concluded that diversion of medical marijuana was common among adolescents and that this engagement in the marijuana diversion market was associated with a perception that marijuana use was common practice and socially acceptable.

An earlier study by O'Connell and Bou-Matar (2007) found that when the qualifying criteria for medicinal marijuana use are defined loosely, as they are in California, there is a strong tendency for users to significantly stretch these definitions to include indications that go beyond uses for which there is evidence of efficacy. The vast majority of users in this study described themselves as daily users (90%), and their most common complaint was chronic pain.

Where recreational marijuana is concerned, US states that have begun to implement recreational marijuana regimes have largely relied on the experience of regulating alcohol production, distribution, sale and consumption (US Library of Congress 2014). The logic of this is deceptively simple: it is frequently argued that marijuana is a social drug like alcohol, and there is an existing regulatory regime for this 'similar' substance. Additionally, states are experienced enough with the operation of this regime to allow it to be quickly adapted to the regulation of marijuana (Hall & Weier 2015).

However, the way the US recreational marijuana industry has so far developed has seen two distinct concepts conflated: the size or scale of the organisations that are allowed to produce marijuana, and who owns them (Caulkins et al. 2015). In the case of Colorado and Washington State, it was decided to not only allow large professional suppliers that can achieve economies of scale and promote a diverse range of products, but also that those suppliers can be private companies whose goal is profit maximisation.

Arguably, the decision to adopt this private–commercial model was based on the logic of alcohol regulation, where the producers, distributors and suppliers are large commercial operators, and the ease with which the model could be adapted. Current alcohol regulatory systems face major criticism, however—particularly from the police and public health sector. For example, it is a common argument that most systems for regulating alcohol give a low priority to protecting public health (Babor et al. 2010), and can be captured and manipulated by large producers to maximise their profits and protect their interests (Room 2014).

Ultimately, it is argued, licensed sellers will seek to maximise their incomes by promoting marijuana use, increasing the number of new users and increasing levels of use among existing users, leading to the commercialisation of sales and expansion of marijuana production and distribution (Hall & Weier 2015; Caulkins et al. 2015; Pacula 2014).

One aspect of this commercial approach that has recently been the subject of study is the growth of advertisements for medical marijuana in California. In a study of more than 8,000 middle school students aged 11–14 years in Southern California, the researchers found that greater initial exposure to medical marijuana advertising was significantly associated with a higher probability of marijuana use and stronger intentions to use one year later, and initial marijuana use and stronger intentions to use were associated with greater medical marijuana advertising exposure one year later (D'Amico, Miles & Tucker 2015). The researchers concluded the issue was significant enough to consider specific prevention programs aimed at young people, together with the development of regulation to control medical marijuana advertising.

The extent to which regulatory systems require detailed consideration has been highlighted by a review, commissioned by the Governor of Vermont, of the necessary conditions for and implications of the possible legalisation of marijuana (Caulkins et al. 2015b). In the review, the authors identify 30 regulatory provisions that might feasibly be required to adequately regulate a legalised marijuana market in Vermont. These 30 areas of regulation are divided into four broad categories:

- product regulations;
- those for sellers or servers and sales;
- marketing; and
- possession or use (Caulkins et al. 2015b:101–114).

Caulkins et al. (2015b) argue that the types of regulation adopted depend on the goals of the state (eg revenue maximisation, harm minimisation and undermining the black market); what market structure policymakers allow; and the number and types of products that are deemed appropriate for legalisation.

Within this broad framework, they go on to define eight key regulatory decisions that must be made to establish an adequate framework for legalising marijuana. These decisions relate to:

- the types of products allowed;
- cannabinoid content;
- retail outlets and delivery services;
- sales to consumers from interstate;
- pricing controls;
- prevention and counter-marketing;
- vertical integration; and
- local autonomy.

In outlining these measures as the basis of a viable regulatory framework, Caulkins et al. also urge the adoption of an adaptive process that responds to changes in consumption patterns, marketing and distribution patterns. Regulation also needs to be responsive to the emergence of illicit or black markets targeting those excluded from the recreational or medicinal marijuana use criteria.

Economic impacts

There are two main economic arguments associated with the benefits (and costs) of legalising marijuana: that it undercuts the price of the illicit market, thereby reducing the involvement of criminal elements in the production, sale and distribution of marijuana; and that it can generate significant tax revenues for any state that legalises marijuana, particularly for recreational use. Others have argued that it generates employment through the commercial production, distribution and sales processes, but there is very little evidence to support this. This review therefore concentrated on the pricepoint and tax revenue arguments.

However, it is first important to reflect on how decisions about legislative models are driven by beliefs about the role of government in the regulatory process. Some advocates for the full repeal of prohibitions on marijuana cultivation and use frequently argue government has no role in regulation and suggest the market will self-regulate. Even those who argue government's role is essential frequently suggest that role should be minimal (Gettman & Kennedy 2012). On the other hand, those with experience of the harms and problems that can arise from the use of other legally available drugs such as alcohol and tobacco—particularly those in the public health and criminal justice sectors—are likely to argue for a significant government role in the regulation of marijuana production, sale and use, even if they are sympathetic to the potential benefits that may flow from changes in availability and access to marijuana (Pacula & Kilmer 2014).

To some extent this debate reflects a deeper ongoing discussion in the United States about the legitimate role of government in the lives of private individuals and the business and market more generally. It is generally agreed, however—except by those on the extreme fringes of this discussion—that it is inevitable and appropriate for legal marijuana to be subject to some form of tax regime, regardless of whether it is for recreational or medicinal use. As might be expected, free marketeers argue this tax should be negligible—largely because they suggest that high taxation rates that drive prices to something similar to black-market prices would create a disincentive to sourcing marijuana legitimately (Gettman & Kennedy 2012). Alternatively, those who have studied the public health benefits of maintaining a high unit price for tobacco and alcohol through vigorous tax regimes argue it is important to keep the unit price relatively high, particularly to discourage early initiation and use among young people (Pacula et al. 2014).

In a study undertaken following California's failed 2010 attempt to legalise recreational marijuana use, Caulkins and Bond (2012) examined the possible impact on retail marijuana prices across the rest of the United States had the California initiative been successful. They were particularly interested in the impact of increased supply due to diversion from California's legalised market on the price of marijuana in jurisdictions where it remained illegal. Using proxy smuggling cost gradients derived from available data on the observed price of Mexican or commercial grade marijuana in different parts of the USA, they concluded that:

...marijuana that is diverted from legal production—even after taxes are collected—would undercut current marijuana prices throughout most of the United States. In particular, they would undercut current sinsemilla prices essentially everywhere, and would undercut commercial-grade prices on a per unit THC basis in the great majority of the United States. Hence, legalizing marijuana production in California would make it economical to supply most

marijuana consumption throughout the United States via marijuana diverted from legal California production. This would create downward pressure on prices throughout the United States...Thus, one state's decision to legalize would create consequences for the country as a whole (Caulkins & Bond 2012: 40).

Caulkins and Bond (2012) go on to suggest that, while it may not be an explicit goal of any state's decision to legalise marijuana use, a state could derive significant benefits if other states do not follow suit. The primary benefits would be taxation revenue and the possible employment generated by the production industry, which would effectively be supplying a market well beyond its domestic market. At the same time, most of the adverse consequences of increased use would accrue beyond its borders.

Since the Caulkins and Bond study, eight states and the District of Columbia have moved to legalise the recreational use of marijuana. Colorado's marijuana tax revenue includes a 2.9 percent retail and medical marijuana sales tax, 10 percent marijuana special sales tax, 15 percent marijuana excise tax, and retail/medical marijuana application and license fees (Colorado Department of Revenue 2015). In its first year of operation, Colorado's recreational marijuana taxation regime collected over US\$70m. In September 2016 alone, Colorado raised in excess of US\$17m from taxing recreational marijuana (Colorado Department of Revenue 2016).

In November 2015, the Colorado electorate voted to approve Proposition BB, which allowed the state government to keep US\$66.1m in excess funds raised through marijuana taxation in the 2014–15 fiscal year. These funds were to be allocated to school construction (US\$40m), youth and substance abuse programs (US\$12m) and a discretionary account (US\$14.1m), most of which is associated with running the tax regime (The Denver Post 3 November 2015). Had the proposition failed, the funds would have reverted to taxpayers in the form of a general tax concession to marijuana growers and to users by way of a temporary reduction in the sales tax for one month. None of those funds would revert to any of the other states that may have been adversely affected by the diversion of Colorado's marijuana into their jurisdictions, as per the Caulkins and Bond (2012) modelling.

While it appears that marijuana prices across the USA are falling as a result of changes to marijuana laws (Hall & Weier 2015; Caulkins et al. 2012; Kilmer et al. 2010), there is little direct evidence of how much they have fallen by. As such, there is little direct evidence of price changes for marijuana on the black market, although it has been asserted that this impact is inevitable (Hall & Weier 2015).

One study by Anderson, Hansen and Rees (2013) collected price data from back issues of *High Times* magazine for the period 1990 to 2011 to gauge the impact of legalising medical marijuana on the marijuana market. They found that legalisation was associated with a 10 to 26 percent decrease in the price of high-quality marijuana, suggesting the supply response to legalising medical marijuana is larger than the demand response. These authors also compared *High Times* prices to prices advertised by dispensaries in Arizona, California, Colorado, Michigan, Nevada, Oregon and Washington. The prices were similar, suggesting there is substantial overlap between the medicinal and recreational markets in these states. This study is a relatively isolated analysis of the price impact of legalisation and points to the need for more directed work to resolve this question.

The significant regulatory costs associated with the management of these legal marijuana regimes is more clear. A significant amount of Colorado's \$14.1m discretionary account is directed towards regulatory costs. In a detailed study of the establishment of a legal marijuana scheme in the state of Vermont, it was suggested that the regulatory costs could be in the mid-range of single million figures (ie probably between US\$5m and US\$10m; Caulkins et al. 2015b: 149), which is less than the current expenditure on marijuana-related law enforcement in Vermont—noting that possession and other user-related offences have already been decriminalised.

The general conclusion, reinforced by the experience so far in Colorado, is that continuing to apply large-scale commercial production models for legalising medical and recreational marijuana has the potential to generate tens of millions in tax revenues for even those states with small populations. It is also likely that these revenues would more than offset the regulatory costs, although these are not insubstantial (Caulkins et al. 2015a). Will these revenue benefits, however, offset the known and potential harms—particularly potential new forms of crime such as the illicit diversion of legitimate marijuana; an increase in impaired driving due to marijuana use; increased use of the drug, particularly among young people; an increase in personal health impacts, particularly mental health impacts; and the effect on the workplace of marijuana intoxication?

This is the question of public health and law enforcement researchers and practitioners in particular (Barry 2014). They are concerned that the lessons learnt from alcohol and tobacco regulation have not been allowed to adequately inform the design of marijuana legalisation schemes (eg Hall & Weier 2015; Pacula et al. 2014). Echoing the views of many who work in the field, Hall and Weier assert:

Alcohol policy analysts would argue that most alcohol regulatory regimes give a low priority to protecting public health. They have often been captured by alcohol producers and sellers who manipulate these regimes to maximise their profits and protect their interests. Others argue that marijuana legalisation will be exploited by the tobacco industry and other large-scale commercial interests to promote marijuana use in much the same way that they promoted tobacco smoking. Commercialisation of sales and an expansion of marijuana production and distribution are likely outcomes of licensed sellers seeking to maximise their incomes by promoting marijuana use, increasing the number of new users, and increasing levels of use among existing users (Hall & Weier 2015: 611)

Impacts on usage patterns

The question most frequently asked about measures to legalise access to marijuana is whether legalisation increases use, particularly among young people. Numerous studies in the United States have sought to answer this question, with somewhat equivocal findings. Using a variety of data sources and statistical techniques, a number of studies have found no relationship between the introduction of medical marijuana laws and adolescent marijuana use (Friese & Grube 2013; Lynne-Landsman, Livingston & Wagenaar 2013; Choo et al. 2014; Harper, Strumpf & Kaufman 2012; Hasin et al. 2015). Indeed, one study found some evidence to suggest that past-month marijuana use by adolescents declined following the introduction of medical marijuana laws (Harper, Strumpf & Kaufman 2012).

Other studies employing similar methods have drawn the opposite conclusion by finding an association between medical marijuana laws and increased use. These studies have found evidence of increased prevalence of use among adolescents (Pacula et al. 2015; Miech et al 2105) and adults (Choi 2014; Wen, Hockenberry & Cummings 2014). Hasin et al. (2015) found young people were younger when they began to use marijuana in states where medical marijuana laws had been introduced.

It is simply too early to reliably assess the impact of legalising recreational marijuana (Hall & Weier 2015; Caulkins et al. 2015a). It has been suggested that it may take up to 10 years to really assess the direct impacts of the changes because of the need to see the longer-term effects on social perceptions of legal marijuana use, among other factors.

Potential personal and social harms and benefits

Marijuana offers potential harms and benefits in health, alcohol use, suicide and accidents.

Health issues

Like other drugs, marijuana use has a long list of potential physical side effects and associated social harms.

Marijuana is a depressant drug that works by slowing down the activity of the central nervous system and the messages going between the brain and the body. When large doses of marijuana are taken it may also produce hallucinogenic effects. The main active chemical in marijuana is THC (delta-9 tetrahydrocannabinol). Scientists are also studying the effects of CBD (cannabidiol) which may have anti-anxiety, antipsychotic and anti-seizure qualities that could prove useful from a medicinal perspective (Caulkins, Kilmer & Kleiman 2016).

The effects of marijuana vary from person to person. How marijuana affects a person depends on many things, including their size, weight and health, whether they are accustomed to taking the drug, whether other drugs are present in their body and the amount taken.

Inhaled drugs reach the bloodstream more quickly than those that are eaten. This means that when marijuana is smoked rather than eaten, the effects can be felt more rapidly, allowing smokers to more effectively control their dose and the desired response. The slower effects of edible marijuana can mean that those consuming such products may be at greater risk of overdose due to the delayed effect resulting in greater consumption than necessary (MacCoun & Mello 2015; Caulkins, Kilmer & Kleiman 2016)

Known effects of low to moderate marijuana use may include:

- loss of inhibition;
- spontaneous laughter;
- quiet and reflective mood;
- altered perception including sound, colour and other sensations;
- altered memory and thinking, confusion;
- anxiety and mild paranoia;
- altered vision and bloodshot eyes;

- relaxation or sleepiness;
- reduced coordination and balance;
- increased heart rate;
- low blood pressure; and
- increased appetite.

Use of marijuana at a higher level or in more concentrated forms can produce the following effects:

- confusion and paranoia;
- restlessness and excitement;
- anxiety and panic;
- detachment from reality; and
- decreased reaction time.

Knowledge of marijuana's long-term effects of marijuana is largely based on studies of those who use marijuana recreationally, rather than those who use (non-inhaled) pharmaceutical preparations for medicinal reasons. These effects may include:

- brain damage resulting in impaired concentration, memory and learning ability;
- damage to lungs including asthma and bronchitis
- a lowered sex drive, irregular menstrual cycle and reduced sperm count;
- damage to the immune system—for example, increased susceptibility to coughs, colds and other conditions associated with an impaired immune system; and
- mental health issues like drug-induced psychosis among heavy long-term users.

There is some evidence that regular marijuana use increases the likelihood of psychotic symptoms in people who are already vulnerable due to a personal or family history of mental illness. It also appears to make psychotic symptoms worse for people with schizophrenia, and using marijuana can lower the chances of recovery from a psychotic episode (Caulkins et al. 2012; ADF 2013).

In terms of the medicinal benefits of marijuana, pharmaceutical preparations have been used to treat the following conditions with varying levels of effectiveness:

- chronic/acute pain—marijuana preparations have been used to treat many types of pain including chronic unexplained pain, rheumatoid arthritis, and pain associated with multiple sclerosis (MS) and cancer. While studies have revealed the benefits of the drug, more testing is required due to potential self-selection bias and recorded side effects;
- nausea and vomiting in patients with cancer or HIV—synthetic preparations have been used to ease nausea and vomiting and to stimulate appetite in these patients. The drug has been shown to relieve symptoms despite more intense side effects, but a Cochrane review concluded more evidence is needed;
- spasticity, muscle cramps and nerve pain associated with multiple sclerosis and Parkinson's disease—while study results have been somewhat mixed, nabiximols (Sativex) has been relatively successful in treating spasms, and is available in some countries where other treatments haven't worked;

- glaucoma—existing treatments have so far proven more effective for glaucoma patients, who typically only obtain very short-term relief from using marijuana, and experience unwanted side effects due to necessary frequent use;
- marijuana withdrawal—though more research is required, Australian trials of nabiximols for the management of marijuana withdrawal have shown it to be safe and effective;
- epilepsy—CBD has anti-convulsive properties but more human research is needed. Trials looking at CBD for the management of severe early-life seizures are under way; and
- inflammatory bowel disease (IBD)—while anecdotal reports of marijuana’s effectiveness in treating IBD exist, no clinical trials have yet occurred (NCPIC 2015).

Alcohol use

Evidence of the relationship between marijuana use and alcohol consumption is mixed. For example, Anderson, Hansen and Rees (2013) found some evidence of a relationship between the legalisation of marijuana and a reduction in self-reported alcohol consumption; there was a reduction in the number of those aged 30–39 years and 50–59 years who reported consuming 15 or more drinks per month. In addition, an examination of traffic accidents by Anderson et al. (2013) tentatively concluded that states with medical marijuana programs reported fewer traffic accidents involving alcohol. In contrast, Wen, Hockenberry and Cummings (2015) found that the introduction of medical marijuana laws were associated with a rise in the frequency of binge drinking, although not a rise in the total number of drinks consumed. This may be due to a relationship between marijuana use and heavy alcohol consumption.

Suicide

Work by Anderson and colleagues provides clearer support for the potential benefits of medical marijuana use as a preventive measure against suicide (Anderson et al. 2014). By comparing statistics from states with medical marijuana laws to statistics of those without, they found that, after medical marijuana was legalised, suicides among men aged 20–39 years fell by comparison with suicides in states that had not legalised medical marijuana. They suggested this negative relationship between the legalisation of marijuana and suicide among young men is consistent with the hypothesis that marijuana can be used to cope with stressful life events.

Accidents

Another important concern associated with marijuana consumption is the risk of accidents such as falls, motor vehicle accidents and workplace accidents. Strictly controlled laboratory trials have provided clear evidence that marijuana use reduces psychomotor performance in ways that increase the overall risk of accident and, in particular, impair driving (Ramaekers et al. 2004). As with alcohol, the degree of impairment is a function of the dose as well as individual factors including age, body mass and length of use (Hall & Degenhardt 2009; Ramaekers et al. 2004). Recent credible evidence from simulated and epidemiological studies indicates that marijuana users who drive while intoxicated are at greater risk of motor vehicle crashes (Room et al. 2010). Further studies conclude that recent marijuana use (indicated by THC in the blood or self-reported use near the time of the accident) more than doubles the risk of a car crash (Asbridge, Hayden, & Cartwright 2012; Couper & Peterson 2014).

There is a considerable amount of ongoing research into what precise levels of THC concentration should constitute threshold levels of concern for activities such as driving and operating machinery. As Caulkins et al. (2015b) point out, if legalisation increases marijuana use then, holding everything else constant, an increase in the proportion of those returning positive results for police tests for THC can be expected; however, this does not necessarily mean that legalisation would lead to a net reduction in traffic safety. Much will depend on how legalisation influences the use of other substances, especially alcohol. Assessments of the effect of marijuana legalisation on traffic safety should focus on the overall accident or fatality rate, not just the number of cases involving marijuana or other substances.

Impact on crime

One of the most consistent arguments for the legalisation of marijuana for either medicinal or recreational use is that it will reduce crime. The logic of this argument is straightforward and utilises the removal of the prohibition on alcohol in 1930s America as an analogy. One of the main points of this argument is that it will remove the influence of crime figures from the manufacture, distribution and sale of the product and effectively reduce crime as a result.

However, as many researchers have documented (see, for example, Musto 1987) this is not really how the removal of prohibition played out. While the production and sale of alcohol was no longer illegal post-prohibition, the crime figures who had profited from the illicit alcohol trade did not disappear; rather, they refocused on other aspects of their businesses such as extortion, prostitution, gambling et cetera.

Caulkins et al. (2015b) examined the probable impacts of marijuana legalisation in Vermont modelling the possible impact on costs to the state's criminal justice system. They concluded that:

...the State of Vermont spent between \$1 million and \$1.3 million enforcing laws against marijuana in FY 2014 but also collected approximately \$200,000 in marijuana-related fines and surcharges. The estimates nonetheless suggest that, after decriminalisation, marijuana charges are now a quite small component of criminal justice costs in Vermont. Although our \$400,000–700,000 estimate for the in-facility costs of incarceration associated with marijuana is the largest component of the total criminal justice cost estimate, it is still a very small fraction of the \$153 million in correctional services costs the state incurred in FY 2014 (Caulkins et al. 2015: 26).

The key point of their analysis was that Vermont had already significantly reduced criminal justice costs directly related to marijuana when it decriminalised the personal use of marijuana. As a result, police and judicial efforts were no longer specifically directed at personal users. Rather, the criminal justice system was picking up those whose marijuana involvement was associated with other criminal actions such as property crime and violence.

The estimated criminal justice cost to the State of Vermont does not include federal expenditure associated with the cross-border trade in marijuana supply.

Caulkins et al. (2015a, 2015b) argue that since nearly 40 times as many current marijuana users live within 300kms of Vermont than in Vermont itself, there is a potential for Vermont to contribute to a significant illicit export industry across borders as well as generating a market for marijuana tourism.

While this may generate a tax windfall for Vermont, it is also likely to bring the state into direct conflict with federal authorities in the same way that initiatives in Colorado, Alaska, Washington and Oregon have raised such concerns.

Diversion of marijuana from medicinal treatment programs is a live issue in the United States (Thurstone et al. 2013), with reported diversion rates as high as 48.8 percent in Colorado. However, it has also been noted that, to a very large extent, the rate of diversion depends on the nature of the medical marijuana schemes and how they have been implemented and regulated (Hall & Weier 2015).

It is also likely, considering the experience of the use of methadone and buprenorphine in opiate replacement therapies in Australia, that rates of diversion are also subject to how the drugs are delivered therapeutically. In a study of opioid pharmacotherapy treatment at community pharmacies in New South Wales, Winstock et al. (2008) found that buprenorphine was diverted at a much higher rate (24%) than methadone (9%) although the drugs provide a similar therapeutic role as opioid substitutes. The study's authors considered this was because buprenorphine is delivered as a tablet and methadone as syrup, making the latter much more difficult to conceal for the purposes of diversion and much less attractive for resale.

However, the message is that even in extremely well managed and regulated drug therapy programs, such as in New South Wales, while there is a market among those unable to qualify for a program or seeking alternative supplies there will continue to be an incentive for diversion.

Conclusions and implications for Australia

The US experience of various legislative changes over that past 20 years shows that changes to marijuana access regimes are a complex and costly regulatory challenge regardless of whether the legislation addresses medicinal or recreational use.

What is quickly apparent from looking at the research is that although over half of US states have now facilitated medical marijuana access (with eight allowing some form of access for recreational use) there are vast differences between the regulatory regimes that apply. As Australia moves to legalise medicinal marijuana treatment, ensuring the regulatory regime for access to, and management of, medicinal marijuana use is critical. Already these issues have been examined by a NSW parliamentary inquiry (NSW Legislative Council 2013).

However, as is clear from the US research, while the primary responsibility for the management of these regimes lies with the states, significant potential problems are emerging that strongly suggest the need for more active engagement by the US Federal Government. Issues such as cross-border diversion and marijuana tourism present important law enforcement challenges, as does the possible emergence of increased drug driving and workplace intoxication issues. Potential future demands for therapeutic treatment facilities for chronic use by an ageing population of users must also be planned for, as demands for access to medicinal marijuana as an adjunct treatment for many of the diseases of age (eg cancer) grow in this older population. At the same time, the implications of any potential increased use by young people remain largely unknown, with conflicting evidence emerging from the research.

One issue generating significant debate in the United States is the nature of the dominant model adopted for the production, distribution and sale of marijuana for both recreational and medicinal use. Large-scale, for-profit commercial systems have been promoted, as lawmakers see the benefits of scale from both a cost-effectiveness (of production) and regulatory perspective. However, some public health advocates and law enforcement representatives see potential dangers in an approach that may lead to similar personal and social problems as have arisen from the commercial promotion and sale of tobacco products and, in particular, alcohol. Among these concerns are the potential for future marketing and advertising campaigns, and the urge by commercial producers to maximise product access and distribution.

For these reasons there has been significant effort put into ensuring that appropriate and effective regulatory frameworks are in place to contain the pressure for market growth. However, developing and implementing regulatory frameworks is not cheap, and significant effort has been made to ensure that the products are taxed at a high level. This has generated income for the state to offset the cost of regulation, as well as ensuring that the real price of marijuana does not drop too low.

At the same time, US lawmakers want to ensure that the real price of legally available marijuana is below that of illicit marijuana, as a disincentive to criminal markets. US states where recreational marijuana is allowed have tried to maintain a reasonably high floor price on marijuana by taxing it. In doing so they must balance the price of legitimate marijuana with the illicit market price to keep it lower; recover adequate tax revenue to finance the regulatory regime; and ensure the price remains high enough to discourage adolescent recruitment.

There is a growing need to address prospects for marijuana diversion and the cross-border transfer of marijuana away from states where it is legal and into those where it is not. The emergence of these issues as problems is largely to do with the piecemeal manner in which law reforms are occurring at the state level, without the active involvement of the federal authorities in developing an overarching regulatory framework.

US marijuana policy, legislation and regulation have been developed over two decades, accompanied by significant research activity. Australia can benefit by learning from these developments. The introduction of Commonwealth legislation to regulate medical marijuana is an example of a policy that avoids one of the pitfalls that can arise when federal legislation is at odds with state laws.

Nevertheless, with New South Wales, Victoria, Queensland, Tasmania and the ACT all taking steps (at the time of writing) towards legalising marijuana for medical purposes, there remain lessons to be learned from the US experience, including the potential for diversion, cross-border trade and the nature of the supply chain.

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