Perspectives

Assessing the public health impact of cannabis legalization in Canada: core outcome indicators towards an ‘index’ for monitoring and evaluation

Benedikt Fischer^{1,2,3,4,5}, Cayley Russell¹, Jürgen Rehm^{1,2,3,6,7}, Pamela Leece^{6,8,9}

¹Institute for Mental Health Policy Research, Centre for Addiction and Mental Health (CAMH), Toronto, Canada M5S 2S1

²Department of Psychiatry, University of Toronto, Toronto, Canada M5T 1R8

³Institute of Medical Science (IMS), University of Toronto, Toronto, Canada M5S 1A8

⁴Centre for Criminology & Sociolegal Studies, University of Toronto, Toronto, Canada M5S 3K9

⁵Department of Psychiatry, Federal University of São Paulo (UNIFESP), 785 05403-903 São Paulo, Brazil

⁶Dalla Lana School of Public Health, University of Toronto, Toronto, Canada M5T 3M7

⁷Institut für Klinische Psychologie und Psychotherapie, Technische Universität Dresden, 01062 Dresden, Germany

⁸Department of Family and Community Medicine, University of Toronto, Toronto, Canada M5G 1V7

⁹Public Health Ontario, Toronto, Canada M5G 1V2

Address correspondence to Benedikt Fischer, E-mail: benedikt.fischer@utoronto.ca

ABSTRACT

The legalization of non-medical cannabis use and supply is impending in Canada. This constitutes a major policy change with the declared objective of improving public health outcomes, which requires rigorous monitoring and evaluation. While numerous different aspects associated with legalization will be examined, a focused perspective is required for effective policy evaluation purposes. To these ends, we have identified a set of 10 core indicators associated with cannabis-related risk/harm outcomes—based on current best evidence—that are expected to measure the primary impacts of legalization on public health outcomes. We briefly review these indicators, and their respective data availability in Canada. As ideally an integrated outcome assessment of cannabis legalization’s impact on public health will be available, we further propose options to merge the individual indicators into an integrated, weighted ‘index’, considering their expected relative impact for public health. One possible approach to undertake this is ‘multi-criteria decision analysis’ as a method to weight the relative indicator impact on public health; alternative approaches are proposed. The integrated ‘public health index’ for cannabis legalization will allow for scientifically comprehensive, while focused, monitoring and evaluation of the effects of legalization in Canada for the benefits of science and evidence-based policy alike.

Keywords Canada, cannabis, harm, indicators, legalization, policy, public health

Introduction

In 2018, Canada will move to legalize, and regulate, the non-medical use and supply of cannabis.¹ This will constitute a fundamental policy change—or ‘social experiment’²—for Canada, following a century of control of cannabis by means of criminal law.³ It will also be a landmark reform internationally, as Canada will be the only G-20 nation to legalize cannabis (and the second nation to do so, following Uruguay).^{1,4,5}

Major objectives of cannabis legalization in Canada include the protection of ‘public health and safety’.¹ While, by standard (e.g. burden of disease) measurements, the public health burden of cannabis is smaller than that for licit

drugs (e.g. alcohol or tobacco), and other illicit substances, it is substantial by international and Canadian assessments.^{6–8}

Given the stated objectives, it is essential to systematically monitor and evaluate the impact of legalization on public health outcomes. In general, major substance—or health—policy reforms should be rigorously evaluated for evidence-based policy principles.^{2,9,10} This is even more important here, as the likely impacts of cannabis legalization are

Benedikt Fischer, Senior Scientist and Chair in Addiction

Cayley Russell, Research Analyst

Jürgen Rehm, Senior Scientist and Chair in Addiction Policy

Pamela Leece, Public Health Physician

uncertain, at best; experiences in other jurisdictions are mixed.¹¹ For example, increases in select acute harm outcomes—e.g. cannabis-impaired driving, hospitalizations, poisoning calls—have been found in the US legalization states (since 2014) of Colorado and Washington.^{12,13}

But how to meaningfully evaluate the impact of cannabis policy reform on public health, especially in a focused fashion? Since announcing the prospects of legalization in Canada, an almost uncountable array of question and data inquiries and efforts into different aspects of cannabis use and harms have been discussed and initiated, e.g. by governments, funding agencies and researchers.¹⁴ Assessments from other legalization jurisdictions, to date, also mainly present individual data or outcome pieces.^{12,15} However, it is unclear whether these will generate both concise while comprehensive summary information, or allow for overall conclusions on the public health impact of legalization.

On this basis, we outline a core set, and subsequent ‘index’ framework, of 10 essential indicators for monitoring health impacts of cannabis legalization within the specific case study of Canada. The indicators presented are derived from currently best conceptual and empirical evidence, and documented to be—directly or indirectly—linked to population-level health harms,^{16–18} thus comprising essential outcomes for public health and a focused ‘gauge’ on legalization impact.^{9,16} We believe that if this core set of indicators—combined with the weighted ‘index’ laid out—is monitored over a sufficient examination period, the empirical impact of cannabis legalization on public health in Canada can be meaningfully ascertained for both science and policy-making purposes.

Cannabis use prevalence

A common question concerning the consequences of legalization is whether cannabis use in the population will increase. While ‘use’ is not a tangible harm in itself,¹⁶ it constitutes the necessary exposure to any possible cannabis-related harm, and should be measured on this basis alone. In the USA, cannabis use rates (including among young people), have been found higher among jurisdictions with liberalized (legal) cannabis regimes (e.g. through ‘medical marijuana’) compared to non-legalization states; however, these appear to be mainly ecological rather than representing causal effects.^{19,20} Importantly—and specifically in Canada—current (e.g. past-year) cannabis use prevalence has fluctuated in the Canadian adult population (e.g. from 7.4% (1994) to 14.1% (2004))^{21,22} despite consistent policy parameters. Distinctly relevant for cannabis use levels in the population is use initiation among young people. Specifically, ‘age of initiation’ is a strong predictor of subsequent cannabis-related problems, as inversely

related to risk for future acute and chronic (e.g. brain functioning, mental health, educational) problem outcomes.^{23–27} Hence, in addition to cannabis use prevalence in the population, age of use initiation should be a focus of monitoring. In Canada—national and provincial—general (e.g. adult, youth/student) population surveys can provide relevant data.^{22,28,29}

Patterns of use

Just like for other psychoactive substance use (e.g. alcohol), harm outcomes are unequally distributed across cannabis users; rather, specific patterns of use are recognized as a major predictor of acute and chronic adverse outcomes.^{30,31} Specifically, intensive or frequent (e.g. daily or near-daily) patterns of cannabis use are associated with increased risk for brain functioning and mental health problems, dependence, and other outcomes.^{30,32–36} Various survey data (e.g. among North American adults/adolescents) show that the proportion of frequent (i.e. daily/near-daily) cannabis users has almost doubled since the early 2000’s.^{21,22,37} Thus, while legalization may not influence the overall prevalence of use, it—for example, through changing cannabis availability and/or social norms—may lead to increases in use patterns, and subsequent population-level harm outcomes.^{9,38,39} Frequency patterns of cannabis use can be measured with relevant items in general population surveys; these items, however, have been defined inconsistently in surveys in the past.

Modes of use

Modes of cannabis use have greatly diversified in recent years.⁴⁰ While, for long, the predominant mode of cannabis use occurred by smoking burnt cannabis products (e.g. a ‘joint’), various alternative use modes have become popular,^{41,42} including inhalation-based (e.g. vaporizer/e-cigarette utilizing electronic processes) as well as non-inhalational (e.g. edible/drinkable) modes.⁴⁰ Smoking ‘burnt’ cannabis remains the most common use mode according to (US- and Canada-based) survey data, with however, up to one in three users reporting alternative (non-smoking) use modes.^{29,41,43} Cannabis use modes influence key public health-relevant outcomes. Specifically, cannabis ‘smoking’ is associated with a variety of acute and chronic bronchial/pulmonary problems, and may independently be associated with lung cancer.^{44–46} While available non-smoking use modes come with some of their own distinct risks (e.g. specific toxins, psychoactive delay and over-use effects), and more rigorous studies are needed to compare inter-mode outcomes, some of these alternatives (e.g. vaporized or edible cannabis use) can overall be assumed to be safer at least for pulmonary-bronchial health outcomes.⁴⁰ Based on its mandate for direct

education and regulation, legalization may influence and promote (safer) use modes among users.^{16,40} Monitoring of cannabis use modes can occur both based on user surveys, as well as retail distribution/sales data for different (e.g., mode-specific) cannabis products.

Cannabis potency

Potency of cannabis products—i.e. primarily its tetrahydrocannabinol (THC) content concentration—is positively associated with the risk for severe (acute and chronic) adverse outcomes.^{31,47,48} Concretely, high-potency cannabis is associated with a 3-fold risk for a psychotic disorder.^{49–53} Despite contexts of varying cannabis control regimes, cannabis potency levels have substantially increased in different jurisdictions (including North America but also Europe) in recent decades.^{54–58} For example, average THC values for cannabis flower products have increased from ~4 to ~12% or higher in the US 1994–2014; similar trends have been reported from Europe;^{55,57} newer THC extract (concentrate) products (e.g. ‘shatter’) reach THC concentrations of up to 80–90%.^{59,60} Similarly, in Canada, limited evidence indicates current average THC concentrations ranging between 15 and 20%.^{61–63} At the same time, the psychoactive potency of cannabis products may be moderated by other cannabinoid components (e.g. CBD).^{64–66} Furthermore, the possibility of users ‘titrating’ higher-potency cannabis, and thus reducing their dose-intake, exists, yet evidence is limited.⁶⁷ Overall, the potency of cannabis products consumed is an important indicator to measure for public health outcomes; basic information can be monitored both from (legal) product sales information and/or population survey data (i.e., legal and illegal products used).

Cannabis product sourcing

A large extent of legalization’s expected public health benefits rests on the assumption that users will switch from illegal (e.g. ‘black market’) to legal (e.g. retail) sources to obtain regulated and quality-controlled cannabis products.^{1,16} For long before legalization, illegal cannabis markets have been well-established and active in Canada, and were recently (2015) estimated to be more than \$6 billion in value;^{68–70} even for minors, accessing cannabis products is as easy as obtaining alcohol or tobacco.^{28,37} Moreover, illicit cannabis markets are not bound by regulatory restrictions, and are highly adaptable.^{10,71} Thus, it cannot be safely assumed to which extent users will switch from illegal to legal cannabis sources under legalization, for various factors that may include product availability, pricing, access and other restrictions or regulations (as well as potentially other subjective or ‘cultural’ factors).⁷² Recent survey data indicate

that among a convenience sample of self-identified users from US legalization states, 45% were still purchasing cannabis from the black market.⁷³ A failure to bring at least a substantial majority of cannabis users into legal cannabis distribution may crucially undermine the potential to realize the desired benefits of legalization.^{10,74} This, hence, is a key indicator for monitoring for which relevant data can be generated from both (user) surveys, as well as licit distribution (sales) and illicit market (e.g. enforcement) data.

Cannabis-impaired driving and injuries

Seminal studies indicate that acute cannabis-impairment—i.e. as occurring shortly following use—is associated with moderately elevated risk (factor 2–4) for motor-vehicle accident involvement, and related injuries and/or fatalities;^{75–77} these risks are further elevated in combination with alcohol.^{78,79} This makes cannabis-impaired driving a - while rare - direct cannabis-related cause of mortality.^{8,80,81} In Canada, approximately 3% of general population adults, but as many as 9% among young drivers (or about one in three cannabis users in the respective age groups), report (past-year) cannabis-impaired driving.^{29,82–85} Roadside driver and emergency room admission samples indicate somewhat higher rates of cannabis-exposure, respectively,^{86,87} and recent estimates found cannabis-impaired driving to be a lead contributor of cannabis-attributable disease burden for Canada (both morbidity/mortality counts as well as DALYs).^{8,80,81} With this major impact potential, it is uncertain how cannabis-impaired driving will evolve under legalization. While greater cannabis availability may lead to increases, intensified targeted interventions (e.g. prevention or enforcement) may lead to reductions in cannabis-impaired driving and subsequent harm.^{88,89} In US legalization states, increases in cannabis-impaired driving injuries have been observed.¹² To monitor these key harm indicators, general population and driver (roadside) surveys, as well as emergency room and accident fatality data (e.g. from coroner’s reports) can be utilized.

Hospitalizations (including poisonings)

Cannabis use can lead to severe acute and/or chronic morbidity requiring hospitalization (including emergency departments), for example, psychotic symptoms, poisonings and accident-related injuries.^{17,18} These, due to severity and consequences, are important contributors to, and indicators of, the cannabis-related public health burden. A California-based study documented that all-cause hospitalization rates among cannabis users were ~50% elevated compared to non-users;⁹⁰ European data indicate similarly elevated rates in cannabis-related hospitalizations, primarily for mental health outcomes.^{91,92} In Colorado, substantial (i.e. >doubling)

increases in cannabis-related hospitalizations have occurred through different steps (i.e., medical and recreational) of cannabis legalization (2001–13).^{12,93} In addition, cannabis-related poison center calls have increased in states with legalized cannabis.^{93–95} In Canada, rates of cannabis-related hospital separations have increased pre-legalization, from 4.64 to 6.49/100 000 population (2011/12–2015/16);⁹⁶ select provincial data also indicate increases in cannabis-related poison center calls.⁹⁷ In Canada's single-payer/public healthcare system, data on cannabis-related hospitalizations are available from respective (provincial) administrative healthcare utilization databases, based on respective ICD-codes and established data collection mechanisms (e.g. the National Ambulatory Care Reporting System [NACRS]); poison call data can be available from provincially mandated poison centers.

Cannabis use disorders

A serious adverse (chronic) cannabis use outcome is cannabis use disorder (CUD, including dependence), measured by standardized diagnostic tools.^{98–100} Typically, CUD is a consequence of intensive (e.g. chronic/frequent and/or high-potency) cannabis use and requires professional treatment.⁹⁸ Older estimates suggest that about 1-in-10 cannabis users develop dependence; recent (e.g. US-based) estimates indicate that as many as one-in-three current users meet CUD criteria.^{101,102} Several (e.g. European) jurisdictions indicated recent increases in CUD treatment demand, especially among young people.^{18,103,104} While CUD has been estimated to be a main cannabis-related burden of disease contributor,^{8,80} cannabis-related treatment demand data in Canada are sporadic and inconsistent. Among (publicly funded) treatment agencies in Ontario, the number of cannabis-related treatment admissions has been stable at ~30 000 annual cases (2007/08–2015/16).^{105,106} In Nova Scotia, this rate however has increased by about 50% (2009/10–2011/12).^{107,108} Given the severity of CUD as both a health outcome and considering its intervention needs, it is a key public health indicator to monitor post-legalization, where population-level use may become more intensive and thus problematic. In Canada, only select provincial, but no national, databases limited to publicly funded treatment services exist,^{106,109,110} implying limitations on data scope and quality for monitoring.

Other psychoactive substance use

Beyond direct cannabis use-related health outcomes, there is good reason to assess possible indirect consequences on population-level health outcomes under legalization. A key

issue, specifically, concerns how availability of legal cannabis may impact the risky use of, or morbidity/mortality harm associated with, other commonly used psychoactive substances (e.g. [prescription] opioids, alcohol or tobacco) through so-called 'substitution' effects; conversely (undesirable) 'complementarity' effects may occur.^{111,112} Concretely, US-based studies documented that increased (legal) cannabis availability through medical (13 states, 1999–2010) or recreational (Colorado, 2000–15) legalization has been associated with reductions in opioid-related mortality,^{113–115} although these studies are largely ecological.¹¹⁶ Furthermore, associations with reductions in opioid-related hospitalizations and driving fatalities have been observed.^{117,118} For alcohol, increased cannabis use may be associated with reductions in risky drinking as well as injuries (e.g. driving-fatalities), however, existing evidence is mixed and inconsistent, and rigorous studies are lacking.^{112,119–122} Furthermore, there is some—yet also inconsistent—evidence that increases in legal cannabis supply and use may be associated with increasing tobacco (mainly co-) use.^{123–125} In Canada, no systematic population-level data on either outcome exist. As the aforementioned substance groups (e.g. opioids, alcohol and tobacco) are exerting extensive public health tolls, respective substitution effects might be beneficial for public health; these may however be outweighed by adverse complementarity effects (e.g. from tobacco use) or by increases in cannabis-related disease burden.^{120,122,126} Over-time analyses in respective general population survey, or injury/fatality datasets, would allow for ecological assessments of possible inter-substance use and harm outcomes; more rigorous analyses could be conducted with longitudinal cohort/population samples.

Cannabis-related 'harm-to-others'

While the focus of most cannabis-related harms is on outcomes with users, an important complementary perspective is 'harm-to-others', i.e. 'non-users' or the social environment. The 'harm-to-others'-concept has become well-established for other substance (e.g. alcohol and tobacco) use realms, and can include health harms, e.g. injuries or disease (e.g. from violence or smoke), or quality-of-life hazards, occurring with others.^{127–129} The concept's relevance for cannabis use is underscored by the fact that greater than four-in-five Canadians are current non-users,²² yet potentially vulnerable to related harms. While cannabis' main effects, based on its distinct pharmacological-behavioral properties (unlike other psychoactive substances) do not involve extensive aggression or violence, its impairment or other use consequences (e.g. cannabis smoking) may result in substantial inconvenience or

harm-to-others.^{130–132} A specific ‘harm-to-others’ consequence may include development issues among un-/new-born infants of cannabis-using mothers, although evidence is limited.^{133,134} Potential ‘harm-to-others’ dynamics are illustrated in emerging Canadian (provincial) regulations for permitted cannabis use locations, with some restricted to ‘private homes’ only.^{74,135} Particularly with legalization policy aiming for ‘public’ health and safety, ‘harm-to-others’ constitutes an essential element for outcome monitoring.^{1,71} Its assessment can occur through relevant items in general population surveys (including both users and non-users), similar to what has been used for alcohol, yet also comprise other ‘social cost’ perspectives.¹³⁶ Specific types of cannabis-related harm-to-others (e.g. injuries, harm to infants) would require data which is not easily or readily available with respective diagnostics.

Discussion

Main finding

The legalization of non-medical cannabis use is imminent in Canada, following similar reforms elsewhere. While it continues to be controversially discussed, primary objectives of cannabis legalization as a major policy reform include the protection of public health and safety in Canada. Also in the context of (mixed) experiences with similar reforms elsewhere to date,¹³⁷ and given the various—acute and chronic—well-documented health risks associated with cannabis use,¹⁷ the outcomes of the legalization policy ‘experiment’ on public health need to be rigorously monitored and evaluated. To that end, we have presented 10 groups of principal indicators which, based on current information, will express and allow the assessment of the main impacts of cannabis legalization on public health relevant risks and outcomes in the population. This, ideally, will occur based on data including baseline (i.e. pre-legalization) data and trends, yet still be valuable if mainly including longitudinal observations post-legalization. On this basis, implementing these indicators will allow for both a comprehensive but focused monitoring and evaluation effort for the impacts of cannabis legalization on public health.

What is already known on this topic

The risks for acute and chronic health harms associated with cannabis use are well documented.¹⁷ While, on population levels, many of these have substantially evolved under relatively consistent control conditions (e.g. prohibition), there is good reason to assume that they may further change with legal cannabis availability and use. To that extent, ongoing cannabis legalization experiments—e.g. in US states

or Uruguay—have shown rather mixed outcomes, i.e. with certain health outcome indicators such as cannabis-related treatment admissions remaining stable, but others, such as cannabis-related accidents and hospitalizations increasing.^{12,137} In Canada, many such indicators will be examined individually and/or within select sub-groups. Neither the ongoing international legalization experiments, nor the—many—planned Canadian outcome evaluation efforts, however, have presented or developed monitoring approaches to assess or gauge the impact of legalization on public health overall.

What this study adds

On their own, the here proposed outcome indicators still consist of individual measures which may see differential involvement—partly independent—of one another, and in themselves will not yet provide an integrated assessment of public health impacts of legalization (as policy-makers ideally utilize for evidence-based policy assessments).^{138–140} Furthermore, each of the indicators features (quantitatively) differential potential impact on the public health burden. Thus, towards further meaningful development and utilization of the public health indicators presented, we propose for these to be integrated into a weighted ‘index’ to measure the impact of cannabis legalization on public health. This should involve scaling (for inter-indicator comparability) and relative weighting of the individual indicators, considering the expected relative individual impact of each on overall public health burden.^{141,142} On this basis, monitoring data can then be combined into ongoing weighted index values (e.g. for regular, annual, measurements).^{141,143} For example, it can be expected that ‘cannabis use disorder’ or ‘cannabis-impaired driving’ outcomes will be associated with substantially higher public health burden than cannabis-related ‘harm-to-others’ or ‘use modes’; this relative ‘weighting’ ought to be defined for each measure towards, and reflected in, an integrated index.

Various scientifically established methods for such weighted indexing exist. If the final outcome is unidimensional—such as burden of disease, which is usually measured as disability-adjusted life years (a summary indicator composed of years of life lost due to premature mortality and disability)¹⁴⁴—an index can be construed via epidemiologic modeling. This index can subsequently be re-assessed and compared, if the associations between indicators and outcome, and the assumptions behind them, remain stable. If more than one dimension is involved, human judgment and valuations about relative impact explicitly come into play. Another option is to assemble an index with the help of ‘multi-criteria decision analysis’ (MCDA).^{145–147} MCDA

involves (at times subjective) expert judgment and valuations, and is usually applied to consider and integrate different factors towards policy-relevant decisions or outcomes, e.g. in health or other policy settings.^{148,149} MCDA has also been applied in the ‘drug policy’ field, to compare and rank the harm potential of different psychoactive substances based on multiple criteria.^{142,150} Independent of the chosen approach to combine and integrate the above indicator dimensions into a composite index, actual values, and over-time changes for each of the indicators could be weight-scored over regular monitoring points, and so allow for longitudinal integrated assessments of public health outcomes following cannabis legalization.

Limitations

The present study presents a conceptual framework for empirical measurement. The proposed indicators are data-driven but selective, and may not capture the full public health impact associated with cannabis legalization. Indicator changes to be observed may include ecological effects. Proposed indicator integration and indexing may involve subjective judgments for weighting towards approximated composite outcome assessments.

Conclusions

Cannabis legalization towards public health ends—like other major policy reforms—requires rigorous monitoring and evaluation, as to whether the main policy objectives are met and/or adjustments are needed.^{10,71,151} Numerous individual—and likely inconsistent—outcomes associated with legalization will be observed, however, a scientifically solid ‘big picture’ assessment of legalization’s impact on public health will be required in Canada for evidence-based policy evaluation.^{138,139} The proposed 10 key outcome indicators, and options for integration into a cannabis public health ‘indicator index’, offer such a—timely—tool that is relatively easy and feasible to develop and implement towards these ends.

Funding

This work was supported by the Canadian Institutes of Health Research (CIHR) for the Canadian Research Initiative in Substance Misuse (CRISM) Ontario Node Team [Grant #SMN-139150], and by the Chair in Addiction, Department of Psychiatry, University of Toronto.

Conflict of interest

The authors have no conflicts of interest to declare.

References

- 1 Task Force on Cannabis Legalization and Regulation. *A Framework for the Legalization and Regulation of Cannabis in Canada: The Final Report of the Task Force on Cannabis Legalization and Regulation*. Ottawa, ON: Government of Canada, 2016.
- 2 Campbell DT. Reforms as experiments. *Am Psychol* 1969;**24**:409–29.
- 3 Room R, Fischer B, Hall W *et al.* *Cannabis Policy: Moving Beyond Stalemate*. New York, NY: Oxford University Press, 2010.
- 4 Pardo B. Cannabis policy reforms in the Americas: a comparative analysis of Colorado, Washington, and Uruguay. *Int J Drug Policy* 2014;**25**:727–35.
- 5 Cerdá M, Kilmer B. Uruguay’s middle-ground approach to cannabis legalization. *Int J Drug Policy* 2017;**42**:118–20.
- 6 Degenhardt L, Ferrari AJ, Calabria B *et al.* The global epidemiology and contribution of cannabis use and dependence to the global burden of disease: results from the GBD 2010 study. *PLoS One* 2013;**8**:e76635.
- 7 Degenhardt L, Whiteford HA, Ferrari AJ *et al.* Global burden of disease attributable to illicit drug use and dependence: findings from the Global Burden of Disease Study 2010. *Lancet (London, England)* 2013;**382**:1564–74.
- 8 Imtiaz S, Shield KD, Roerecke M *et al.* The burden of disease attributable to cannabis use in Canada in 2012. *Addiction* 2016;**111**:653–62.
- 9 Hall W, Lynskey M. Evaluating the public health impacts of legalizing recreational cannabis use in the United States. *Addiction* 2016;**111**:1764–73.
- 10 Fischer B, Rehm J, Crepault JF. Realistically furthering the goals of public health by cannabis legalization with strict regulation: response to Kalant. *Int J Drug Policy* 2016;**34**:11–6.
- 11 Dills AK, Goffard S, Miron J. *The Effects of Marijuana Liberalizations: Evidence From Monitoring the Future*. Cambridge, MA: National Bureau of Economic Research, 2017.
- 12 Rocky Mountain High Intensity Drug Trafficking Area. *The Legalization of Marijuana in Colorado: The Impact Volume 5*. Denver, Colorado: Rocky Mountain High Intensity Drug Trafficking Area, 2017.
- 13 Forecasting and Research Division. *Monitoring Impacts of Recreational Marijuana Legalization: 2016 Update Report*. Olympia, Washington: Forecasting and Research Division, Washington State Office of Financial Management, 2017.
- 14 The Canadian Press. 14 Marijuana research projects across Canada to receive federal funding. *Global News*. 2018. <https://globalnews.ca/news/3984777/marijuana-research-projects-federal-funding/> (29 January 2018, date last accessed).
- 15 Northwest High Intensity Drug Trafficking A. *Washington State Marijuana Impact Report*. Seattle, Washington: Northwest High Intensity Drug Trafficking Area, 2016.
- 16 Fischer B, Russell C, Sabioni P *et al.* Lower-Risk Cannabis Use Guidelines (LRCUG): a comprehensive update of evidence and recommendations. *Am J Public Health* 2017;**107**(8):e1–e12.
- 17 National Academies of Sciences Engineering and Medicine. *The Health Effects of Cannabis and Cannabinoids: The Current State of*

- Evidence and Recommendations for Research*. Washington, DC: The National Academies Press, 2017.
- 18 World Health Organization (WHO). *The Health and Social Effects of Nonmedical Cannabis Use*. Geneva, Switzerland: World Health Organization (WHO), 2016.
 - 19 Hasin DS, Wall M, Keyes KM *et al*. Medical marijuana laws and adolescent marijuana use in the USA from 1991 to 2014: results from annual, repeated cross-sectional surveys. *Lancet Psychiatry* 2015;**2**:601–8.
 - 20 Stolzenberg L, D'Alessio SJ, Dariano D. The effect of medical cannabis laws on juvenile cannabis use. *Int J Drug Policy* 2016;**27**: 82–8.
 - 21 Canadian Centre on Substance Abuse (CCSA) and Health Canada. *Canadian Addiction Survey (CAS): A National Survey of Canadians' Use of Alcohol and Other Drugs—Prevalence of Use and Related Harm*. Ottawa, ON: Canadian Centre on Substance Abuse (CCSA), 2004.
 - 22 Health Canada. *Canadian Tobacco, Alcohol and Drugs Survey (CTADS): Summary of Results for 2015*. Ottawa, ON: Health Canada, 2016.
 - 23 Jacobus J, Tapert SF. Effects of cannabis on the adolescent brain. *Curr Pharm Des* 2014;**20**:2186–93.
 - 24 Lisdahl KM, Gilbert ER, Wright NE *et al*. Dare to delay? The impacts of adolescent alcohol and marijuana use onset on cognition, brain structure, and function. *Front Psychiatry* 2013;**4**:53.
 - 25 Camchong J, Lim KO, Kumra S. Adverse effects of cannabis on adolescent brain development: a longitudinal study. *Cereb Cortex* 2017;**27**:1922–30.
 - 26 Volkow ND, Swanson JM, Evins AE *et al*. Effects of cannabis use on human behavior, including cognition, motivation, and psychosis: a review. *JAMA Psychiatry* 2016;**73**:292–7.
 - 27 Stefanis NC, Dragovic M, Power BD *et al*. Age at initiation of cannabis use predicts age at onset of psychosis: the 7-to 8-year trend. *Schizophr Bull* 2013;**39**:251–4.
 - 28 Health Canada. *Summary of Results: Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS) 2014-15*. Ottawa, ON: Health Canada, 2016.
 - 29 Health Canada. *Canadian Cannabis Survey: 2017 Summary*. Ottawa, ON: Health Canada, 2017.
 - 30 Marconi A, Di Forti M, Lewis CM *et al*. Meta-analysis of the association between the level of cannabis use and risk of psychosis. *Schizophr Bull* 2016;**42**:1262–9.
 - 31 Hall W, Degenhardt L. Adverse health effects of non-medical cannabis use. *Lancet* 2009;**374**:1383–91.
 - 32 Batalla A, Bhattacharyya S, Yucel M *et al*. Structural and functional imaging studies in chronic cannabis users: a systematic review of adolescent and adult findings. *PLoS One* 2013;**8**:e55821.
 - 33 Lorenzetti V, Solowij N, Whittle S *et al*. Gross morphological brain changes with chronic, heavy cannabis use. *Br J Psychiatry* 2015;**206**: 77–8.
 - 34 Lev-Ran S, Roerecke M, Le Foll B *et al*. The association between cannabis use and depression: a systematic review and meta-analysis of longitudinal studies. *Psychol Med* 2014;**44**:797–810.
 - 35 van der Pol P, Liebrechts N, de Graaf R *et al*. Predicting the transition from frequent cannabis use to cannabis dependence: a three-year prospective study. *Drug Alcohol Depend* 2013;**133**:352–9.
 - 36 Degenhardt L, Coffey C, Romaniuk H *et al*. The persistence of the association between adolescent cannabis use and common mental disorders into young adulthood. *Addiction* 2013;**108**:124–33.
 - 37 Azofeifa A, Mattson ME, Schauer G *et al*. National estimates of marijuana use and related indicators—National Survey on Drug Use and Health, United States, 2002–2014. *MMWR Morb Mortal Wkly Rep* 2016;**65**:1–28.
 - 38 Hall W, Weier M. Assessing the public health impacts of legalizing recreational cannabis use in the USA. *Clin Pharmacol Ther* 2015;**97**: 607–15.
 - 39 Asbridge M, Valleriani J, Kwok J *et al*. Normalization and denormalization in different legal contexts: comparing cannabis and tobacco. *Drugs Educ Prev Policy* 2016;**23**:212–23.
 - 40 Russell C, Rueda S, Room R *et al*. Routes of administration for cannabis use—basic prevalence and related health outcomes: a scoping review and synthesis. *Int J Drug Policy* 2018;**52**:87–96.
 - 41 Schauer GL, King BA, Bunnell RE *et al*. Vaping, and eating for health or fun: marijuana use patterns in adults, U.S., 2014. *Am J Prev Med* 2016;**50**:1–8.
 - 42 Borodovsky JT, Crosier BS, Lee DC *et al*. Smoking, vaping, eating: is legalization impacting the way people use cannabis? *Int J Drug Policy* 2016;**36**:141–7.
 - 43 Singh T, Kennedy SM, Sharapova SS *et al*. Modes of ever marijuana use among adult tobacco users and non-tobacco users—Styles 2014. *J Subst Use* 2016;**21**:631–5.
 - 44 Martinasek MP, McGrogan JB, Maysonet A. A systematic review of the respiratory effects of inhalational marijuana. *Respir Care* 2016;**61**:1543–51.
 - 45 Bouti K, Rajae B, Hicham F *et al*. Cannabis smoking and risk of lung cancer: a systematic review and meta-analysis. *Int J Med Surg* 2014;**1**:31–7.
 - 46 Hashibe M, Morgenstern H, Cui Y *et al*. Marijuana use and the risk of lung and upper aerodigestive tract cancers: results of a population-based case-control study. *Cancer Epidemiol Biomarkers Prev* 2006;**15**:1829–34.
 - 47 Hall W, Degenhardt L. High potency cannabis: a risk factor for dependence, poor psychosocial outcomes, and psychosis. *Br Med J (Clinical research ed)*. 2015;**350**:h1205.
 - 48 Volkow ND, Baler RD, Compton WM *et al*. Adverse health effects of marijuana use. *N Engl J Med* 2014;**370**:2219–27.
 - 49 Di Forti M, Marconi A, Carra E *et al*. Proportion of patients in south London with first-episode psychosis attributable to use of high potency cannabis: a case-control study. *Lancet Psychiatry* 2015;**2**:233–8.
 - 50 Pierre JM, Gandal M, Son M. Cannabis-induced psychosis associated with high potency 'wax dabs'. *Schizophr Res* 2016;**172**:211–2.
 - 51 Ramaekers JG, Kauert G, van Ruitenbeek P *et al*. High-potency marijuana impairs executive function and inhibitory motor control. *Neuropsychopharmacology* 2006;**31**:2296–303.
 - 52 Di Forti M, Sallis H, Allegri F *et al*. Daily use, especially of high-potency cannabis, drives the earlier onset of psychosis in cannabis users. *Schizophr Bull* 2014;**40**:1509–17.
 - 53 Freeman TP, Winstock AR. Examining the profile of high-potency cannabis and its association with severity of cannabis dependence. *Psychol Med* 2015;**45**:3181–9.

- 54 Cascini F, Aiello C, Di Tanna G. Increasing delta-9-tetrahydrocannabinol (Delta-9-THC) content in herbal cannabis over time: systematic review and meta-analysis. *Curr Drug Abuse Rev* 2012;**5**:32–40.
- 55 Niesink RJ, Rigter S, Koeter MW *et al*. Potency trends of Delta-9-tetrahydrocannabinol, cannabidiol and cannabinol in cannabis in the Netherlands: 2005–15. *Addiction* 2015;**110**:1941–50.
- 56 Englund A, Freeman TP, Murray RM *et al*. Can we make cannabis safer? *Lancet Psychiatry* 2017;**4**:643–8.
- 57 ElSohly MA, Mehmedic Z, Foster S *et al*. Changes in cannabis potency over the last 2 decades (1995–2014): analysis of current data in the United States. *Biol Psychiatry* 2016;**79**:613–9.
- 58 Mehmedic Z, Chandra S, Slade D *et al*. Potency trends of Delta-9-THC and other cannabinoids in confiscated cannabis preparations from 1993 to 2008. *J Forensic Sci* 2010;**55**:1209–17.
- 59 Raber JC, Elzinga S, Kaplan C. Understanding dabs: contamination concerns of cannabis concentrates and cannabinoid transfer during the act of dabbing. *J Toxicol Sci* 2015;**40**:797–803.
- 60 Stogner JM, Miller BL. Assessing the dangers of ‘dabbing’: mere marijuana or harmful new trend? *Pediatrics* 2015;**136**:1–3.
- 61 Grundig T, Common D. What’s in your pot? Marketplace tests today’s weed. *CBC News*. 2016. <http://www.cbc.ca/news/canada/marketplace-marijuana-thc-cbd-legalization-1.3861144> (20 March 2018, date last accessed).
- 62 Government of Canada. *About Cannabis*. Ottawa, ON: Government of Canada, 2018.
- 63 Martin B. *ACMPR Market Scan: Dried Cannabis per Gram Pricing vs Cannabinoid Content*. <https://news.lift.co/acmpr-market-scan-dried-cannabis-per-gram-pricing-vs-cannabinoid-content/> (12 December 2017, date last accessed).
- 64 Batalla A, Crippa JA, Busatto GF *et al*. Neuroimaging studies of acute effects of THC and CBD in humans and animals: a systematic review. *Curr Pharm Des* 2014;**20**:2168–85.
- 65 Bhattacharyya S, Morrison PD, Fusar-Poli P *et al*. Opposite effects of delta-9-tetrahydrocannabinol and cannabidiol on human brain function and psychopathology. *Neuropsychopharmacology* 2010;**35**:764–74.
- 66 Iseger TA, Bosson MG. A systematic review of the antipsychotic properties of cannabidiol in humans. *Schizophr Res* 2015;**162**:153–61.
- 67 van der Pol P, Liebrechts N, Brunt T *et al*. Cross-sectional and prospective relation of cannabis potency, dosing and smoking behaviour with cannabis dependence: an ecological study. *Addiction* 2014;**109**:1101–9.
- 68 Macdonald R, Rotermann M. *Experimental Estimates of Cannabis Consumption in Canada, 1960 to 2015*. Ottawa, ON: Economic Analysis Division and Health Analysis Division, Statistics Canada, 2017.
- 69 Tang B, de Ruijter A. *Canadian Cannabis Industry Overview*. Vancouver, BC: Fundamental Research Corp, 2017.
- 70 Press C. Canadian Cannabis Market Worth \$6.2B in 2015: Statistics Canada. *Huffington Post*. 2017. http://www.huffingtonpost.ca/2017/12/18/canadian-cannabis-market-worth-6-2b-in-2015-statistics-canada_a_23310828/ (09 January 2018, date last accessed).
- 71 Rehm J, Fischer B. Cannabis legalization with strict regulation, the overall superior policy option for public health. *Clin Pharmacol Ther* 2015;**97**:541–4.
- 72 Henchman J, Scarboro M. *Marijuana Legalization and Taxes: Lessons for Other States from Colorado and Washington*. Washington, DC: The Tax Foundation, 2016.
- 73 Bolivar LA, Coalition CC. *Cannabis Consumers Coalition: Report on Cannabis Consumer Demographics and Consumption Habits*. Denver, Colorado: Cannabis Consumers Coalition, 2017.
- 74 Fischer B. Legalisation of non-medical cannabis in Canada: will supply regulations effectively serve public health? *Lancet Public Health* 2017;**2**:e536–e7.
- 75 Hartman RL, Huestis MA. Cannabis effects on driving skills. *Clin Chem* 2013;**59**(3):478–92.
- 76 Rogeberg O, Elvik R. The effects of cannabis intoxication on motor vehicle collision revisited and revised. *Addiction* 2016;**111**:1348–59.
- 77 Li M-C, Brady JE, DiMaggio CJ *et al*. Marijuana use and motor vehicle crashes. *Epidemiol Rev* 2012;**34**:65–72.
- 78 Asbridge M, Hayden JA, Cartwright JL. Acute cannabis consumption and motor vehicle collision risk: systematic review of observational studies and meta-analysis. *Br Med J* 2012;**344**:e536.
- 79 Dubois S, Mullen N, Weaver B *et al*. The combined effects of alcohol and cannabis on driving: impact on crash risk. *Forensic Sci Int* 2015;**248**:94–100.
- 80 Fischer B, Imtiaz S, Rudzinski K *et al*. Crude estimates of cannabis-attributable mortality and morbidity in Canada: implications for public health focused intervention priorities. *J Public Health* 2016;**38**:183–8.
- 81 Wetlaufer A, Florica RO, Asbridge M *et al*. Estimating the harms and costs of cannabis-attributable collisions in the Canadian provinces. *Drug Alcohol Depend* 2017;**173**:185–90.
- 82 Canadian Centre on Substance Abuse. *Impaired Driving in Canada*. Ottawa, ON: Canadian Centre on Substance Abuse (CCSA), 2017.
- 83 Health Canada. *Canadian Alcohol and Drug Use Monitoring Survey (CADUMS): Summary Results for 2012*. Ottawa, ON: Government of Canada, 2013.
- 84 Ialomiteanu AR, Hamilton H, Adlaf E *et al*. *CAMH Monitor eReport 2015: Substance Use, Mental Health and Well-Being Among Ontario Adults*. Toronto, Ontario: Centre for Addiction and Mental Health, 2016.
- 85 Boak A, Hamilton HA, Adlaf EM *et al*. *Drug Use Among Ontario Students, 1977-2017: Detailed Findings From the Ontario Student Drug Use and Health Survey (OSDUHS)*. Toronto, ON: Centre for Addiction and Mental Health (CAMH), 2017.
- 86 Beirness DJ, Beasley EE, McClafferty K. *Alcohol and Drug Use among Drivers in Ontario: Findings From the 2014 Roadside Survey*. Ottawa, ON: Ministry of Transportation, 2015.
- 87 Traffic Injury Research Foundation (TIRF). *Marijuana Use Among Drivers in Canada, 2000-2014*. Ottawa, ON: Traffic Injury Research Foundation (TIRF), 2017.
- 88 Anderson P, Chisholm D, Fuhr DC. Effectiveness and cost-effectiveness of policies and programmes to reduce the harm caused by alcohol. *Lancet* 2009;**373**:2234–46.

- 89 Fischer B, Fidalgo T, Varatharajan T. Reflections on Pollini *et al.* (2017)—implications for interventions for driving while using psychotropic medications with impairment risk. *J Stud Alcohol Drugs* 2017;**78**:814–6.
- 90 Gerberich SG, Sidney S, Braun BL *et al.* Marijuana use and injury events resulting in hospitalization. *Ann Epidemiol* 2003;**13**:230–7.
- 91 Jouanjus E, Leymarie F, Tubery M *et al.* Cannabis-related hospitalizations: unexpected serious events identified through hospital databases. *Br J Clin Pharmacol* 2011;**71**:758–65.
- 92 Schubart C, Boks M, Breetvelt E *et al.* Association between cannabis and psychiatric hospitalization. *Acta Psychiatr Scand* 2011;**123**:368–75.
- 93 Kim HS, Monte AA. Colorado cannabis legalization and its effect on emergency care. *Ann Emerg Med* 2016;**68**:71.
- 94 Ghosh TS, Van Dyke M, Maffey A *et al.* Medical marijuana's public health lessons—implications for retail marijuana in Colorado. *N Engl J Med* 2015;**372**:991–3.
- 95 Cao D, Srisuma S, Bronstein AC *et al.* Characterization of edible marijuana product exposures reported to United States poison centers. *Clin Toxicol (Phila)* 2016;**54**:840–6.
- 96 Canadian Institute for Health Information (CIHI). *Crude Separation Rates for Selected Substance-Related Disorders as a Primary Diagnosis, Canada, 2011–2012 to 2015–2016*. Toronto, ON: Hospital Mental Health Database, Canadian Institute for Health Information (CIHI), 2017.
- 97 Cumming E, Kosatsky T. Calls to BC poison control on 4/20: a case-only analysis. *BC Medical Journal* 2018;**60**:62–3.
- 98 Copeland J, Swift W. Cannabis use disorder: epidemiology and management. *Int Rev Psychiatry* 2009;**21**:96–103.
- 99 Stinson FS, Ruan WJ, Pickering R *et al.* Cannabis use disorders in the USA: prevalence, correlates and co-morbidity. *Psychol Med* 2006;**36**:1447–60.
- 100 Budney AJ, Roffman R, Stephens RS *et al.* Marijuana dependence and its treatment. *Addict Sci Clin Pract* 2007;**4**:4–16.
- 101 Hasin DS, Saha TD, Kerridge BT *et al.* Prevalence of marijuana use disorders in the United States between 2001–2002 and 2012–2013. *JAMA Psychiatry* 2015;**72**:1235–42.
- 102 Wagner FA, Anthony JC. From first drug use to drug dependence: developmental periods of risk for dependence upon marijuana, cocaine, and alcohol. *Neuropsychopharmacology* 2002;**26**:479–88.
- 103 McCulloch L. Why did cannabis treatment presentations rise in England from 2004–2005 to 2013–2014? *Drugs and Alcohol Today* 2017;**17**:218–31.
- 104 United Nations Office on Drugs and Crime (UNODC). *World Drug Report 2016*. New York, NY: United Nations, 2016.
- 105 Drug Alcohol Treatment Information System (DATIS). *Substance Abuse Statistical Tables: Fiscal Year 2007/2008 to Fiscal Year 2012/2013*. Toronto, ON: Centre for Addiction and Mental Health, 2013.
- 106 Drug and Alcohol Treatment Information System (DATIS). *Substance Abuse Statistical Tables: Fiscal Year 2010/11–2015/16*. Toronto, ON: Centre for Addiction and Mental Health, 2016.
- 107 Government of Nova Scotia. *Nova Scotia Addiction Services Annual Report: 2009–2010*. Halifax, NS: Government of Nova Scotia, 2011.
- 108 Government of Nova Scotia. *Nova Scotia Addiction Services Annual Report: 2011–2012*. Halifax, NS: Government of Nova Scotia, 2013.
- 109 Rotondi NK, Rush B. Monitoring utilization of a large scale addiction treatment system: The Drug and Alcohol Treatment Information System (DATIS). *Substance Abuse Res Treat* 2012;**6**:73–84.
- 110 Pirie T, Wallingford SC, Di Gioacchino LA *et al.* *National Treatment Indicators Report: 2013–2014*. Ottawa, ON: Canadian Centre on Substance Abuse (CCSA), 2016.
- 111 Fischer B, Murphy Y, Kurdyak P *et al.* Medical marijuana programs—why might they matter for public health and why should we better understand their impacts? *Prev Med Rep* 2015;**2**:53–6.
- 112 Lucas P, Walsh Z, Crosby K *et al.* Substituting cannabis for prescription drugs, alcohol and other substances among medical cannabis patients: the impact of contextual factors. *Drug Alcohol Rev* 2015;**35**:326–33.
- 113 Bachhuber MA, Saloner B, Cunningham CO *et al.* Medical cannabis laws and opioid analgesic overdose mortality in the United States, 1999–2010. *JAMA Intern Med* 2014;**174**:1668–73.
- 114 Livingston MD, Barnett TE, Delcher C *et al.* Recreational cannabis legalization and opioid-related deaths in Colorado, 2000–2015. *Am J Public Health* 2017;**107**(11):1827–9.
- 115 Powell D, Pacula RL, Jacobson M. Do medical marijuana laws reduce addictions and deaths related to pain killers? *J Health Econ* 2018;**58**:29–42.
- 116 Hall W, West R, Marsden J *et al.* It is premature to expand access to medicinal cannabis in hopes of solving the US opioid crisis. *Addiction* 2018;**113**(6):987–8.
- 117 Kim JH, Santaella-Tenorio J, Mauro C *et al.* State medical marijuana laws and the prevalence of opioids detected among fatally injured drivers. *Am J Public Health* 2016;**106**:2032–7.
- 118 Shi Y. Medical marijuana policies and hospitalizations related to marijuana and opioid pain reliever. *Drug Alcohol Depend* 2017;**173**:144–50.
- 119 Anderson DM, Hansen B, Rees DI. Medical marijuana laws, traffic fatalities and alcohol consumption. *J Law Econ* 2013;**56**:33–339.
- 120 Pacula RL, Powell D, Heaton P *et al.* Assessing the effects of medical marijuana laws on marijuana use: the devil is in the details. *J Policy Anal Manage* 2015;**34**:7–31.
- 121 Wen H, Hockenberry JM, Cummings JR. The effect of medical marijuana laws on adolescent and adult use of marijuana, alcohol, and other substances. *J Health Econ* 2015;**42**:64–80.
- 122 Reiman A. Cannabis as a substitute for alcohol and other drugs. *Harm Reduct J* 2009;**6**:35–7517–6–35.
- 123 Wang JB, Ramo DE, Lisha NE *et al.* Medical marijuana legalization and cigarette and marijuana co-use in adolescents and adults. *Drug Alcohol Depend* 2016;**166**:32–8.
- 124 Cerdá M, Sarvet AL, Wall M *et al.* Medical marijuana laws and adolescent use of marijuana and other substances: alcohol, cigarettes, prescription drugs, and other illicit drugs. *Drug Alcohol Depend* 2018;**183**:62–8.
- 125 Schauer GL, Berg CJ, Kegler MC *et al.* Assessing the overlap between tobacco and marijuana: trends in patterns of co-use of tobacco and marijuana in adults from 2003–2012. *Addict Behav* 2015;**49**:26–32.

- 126 Fischer B, Rehm J. Revisiting the ‘paradigm shift’ in opioid use: developments and implications 10 years later. *Drug Alcohol Rev* 2018;**37**(S1):5199–202.
- 127 Stratton K, Shetty P, Wallace R *et al*. Clearing the smoke: the science base for tobacco harm reduction—executive summary. *Tob Control* 2001;**10**:189–95.
- 128 Blackburn C, Spencer N, Bonas S *et al*. Effect of strategies to reduce exposure of infants to environmental tobacco smoke in the home: cross sectional survey. *Br Med J* 2003;**327**:257.
- 129 Room R, Ferris J, Laslett A-M *et al*. The drinker’s effect on the social environment: a conceptual framework for studying alcohol’s harm to others. *Int J Environ Res Public Health* 2010;**7**:1855–71.
- 130 Boles SM, Miotto K. Substance abuse and violence. *Aggress Violent Behav* 2003;**8**:155–74.
- 131 Hoaken PNS, Stewart SH. Drugs of abuse and the elicitation of human aggressive behavior. *Addict Behav* 2003;**28**:1533–54.
- 132 Moore TM, Stuart GL. A review of the literature on marijuana and interpersonal violence. *Aggress Violent Behav* 2005;**10**:171–92.
- 133 Gunn JK, Rosales CB, Center KE *et al*. Prenatal exposure to cannabis and maternal and child health outcomes: a systematic review and meta-analysis. *BMJ Open* 2016;**6**(4):e009986.
- 134 Conner SN, Bedell V, Lipsey K *et al*. Maternal marijuana use and adverse neonatal outcomes: a systematic review and meta-analysis. *Obstet Gynecol* 2016;**128**:713–23.
- 135 The Canadian Press. A Look at Provincial Marijuana Plans. *CTV News*. 2017. <https://www.ctvnews.ca/canada/a-look-at-provincial-marijuana-plans-1.3682177> (5 January 2018, date last accessed).
- 136 Navarro HJ, Doran CM, Shakeshaft AP. Measuring costs of alcohol harm to others: a review of the literature. *Drug Alcohol Depend* 2011;**114**:87–99.
- 137 Maxwell JC, Mendelson B. What do we know about the impact of the laws related to marijuana? *J Addict Med* 2016;**10**:3–12.
- 138 Brownson RC, Chiqui JF, Stamatakis KA. Understanding evidence-based public health policy. *Am J Public Health* 2009;**99**:1576–83.
- 139 Sanderson I. Evaluation, policy learning and evidence-based policy making. *Public Adm* 2002;**80**:1–22.
- 140 Bowen S, Zwi AB. Pathways to ‘evidence-informed’ policy and practice: a framework for action. *PLoS Med* 2005;**2**:e166.
- 141 Babbie E. *The practice of social research*. Toronto, ON: Nelson Education, 2015.
- 142 Nutt DJ, King LA, Phillips LD. Drug harms in the UK: a multicriteria decision analysis. *The Lancet* 2010;**376**:1558–65.
- 143 Groth-Marnat G. *Handbook of Psychological Assessment*. Hoboken, NJ: John Wiley & Sons, 2009.
- 144 World Health Organization (WHO). *Metrics: Disability-Adjusted Life Years (DALY): Quantifying the Burden of Disease from Mortality and Morbidity*. Geneva, Switzerland: World Health Organization (WHO), 2018.
- 145 Dodgson J, Spackman M, Pearman A *et al*. *Multi Criteria Analysis: a Manual*. London, UK: Department of the Environment, Transport and the Regions, 2000.
- 146 Adunlin G, Diaby V, Xiao H. Application of multicriteria decision analysis in health care: a systematic review and bibliometric analysis. *Health Expect* 2015;**18**:1894–905.
- 147 Marsh K, Lanitis T, Neasham D *et al*. Assessing the value of healthcare interventions using multi-criteria decision analysis: a review of the literature. *Pharmacoeconomics* 2014;**32**:345–65.
- 148 Nobre FF, Trotta LTF, Gomes LFAM. Multi-criteria decision making -an approach to setting priorities in health care. *Stat Med* 1999;**18**:3345–54.
- 149 Baltussen R, Niessen L. Priority setting of health interventions: the need for multi-criteria decision analysis. *Cost Eff Resour Alloc* 2006;**4**:14.
- 150 van Amsterdam J, Nutt D, Phillips L *et al*. European rating of drug harms. *J Psychopharmacol* 2015;**29**:655–60.
- 151 Pacula RL, Kilmer B, Wagenaar AC *et al*. Developing public health regulations for marijuana: lessons from alcohol and tobacco. *Am J Public Health* 2014;**104**:1021–8.