Rapid Synthesis

Identifying the Impacts of Cannabis Legalization on Youth, and the Responses that can be Taken by Public Institutions

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McMaster Health Forum
    The goal of the McMaster Health Forum, and its Forum+ initiative, is to generate action on the pressing health- and social-system issues of our time, based on the best available research evidence and systematically elicited citizen values and stakeholder insights. We aim to strengthen health and social systems – locally, nationally, and internationally – and get the right programs, services and products to the people who need them. In doing so, we are building on McMaster's expertise in advancing human and societal health and well-being.

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Timeline
    Rapid syntheses can be requested in a three-, 10- or 30-business day timeframe, and this synthesis was prepared over a 10-business day timeframe. An overview of what can be provided and what cannot be provided in each of the different timelines is provided on the McMaster Health Forum's Rapid-Response program webpage (www.mcmasterhealthforum.org/index.php/stakeholders/rapid-response).

KEY MESSAGES

Question
- Following cannabis legalization in Canada, what are the important health and social outcomes and challenges Canadian youth will likely face, and what approaches to policy and practice should large, student-focused public institutions consider in determining their response to these challenges?

Why the issue is important
- With the Canadian government set to introduce legislation in the spring of 2017 to legalize the use of cannabis, there is a need to plan for any health and social challenges associated with this policy change.
- Following this policy change, public institutions, such as colleges and universities, will need to address the health and social consequences of cannabis legalization on students, faculty and staff (e.g., through the creation of new guidelines or programming that targets cannabis users).
- With 17.9% of post-secondary students in Canada having used cannabis within the last 30 days, and its use being linked with health and social risks, youth may be vulnerable as a result of the federal policy change.
- Therefore, identifying the best available research evidence on the health and social outcomes that youth will face, along with potential approaches to address these challenges, will be an important step as student-focused public institutions grapple with future policy change.

What we found
- Key findings from two systematic reviews, 11 narrative reviews, and six single studies regarding the health and social outcomes of cannabis in youth, include that:
  - use of cannabis can impair reaction time, processing speed, concentration and other cognitive and psychomotor abilities, and pose a risk of psychosis in individuals predisposed to schizophrenia;
  - long-term use of cannabis is associated with risk of cardiovascular disease, cancer, respiratory illness, depression and anxiety;
  - single studies have mixed results regarding levels of perceived risk and frequency of cannabis use after legalization; and
  - some studies show a correlation between cannabis use and subsequent illicit drug use, and cannabis-related deaths after legalization.
- Key findings from 14 systematic reviews, three single studies focused on interventions for preventing, reducing or managing substance use (of which seven of the reviews focused specifically on addressing cannabis use), and eight program and system descriptions/analyses include:
  - there are 25 instruments available that are designed for screening and assessing cannabis use disorders that have good psychometric qualities, but that have limited evidence of effectiveness (although single studies point to an increase in detection of health-risk behaviours and decrease in illicit drug use) and limitations for clinical practice (e.g., time constraints and lack of validity for some use with some populations);
  - several high-quality reviews support the use of cognitive behavioural therapy and motivational interventions, combined with contingency management to reduce cannabis use;
  - a high-quality review finding that psychological and/or psychosocial interventions delivered via digital platforms have a small effect in reducing cannabis use, with the largest effect being found for a web-based online chat with a trained psychotherapist, personal diary and written feedback;
  - mass-media campaigns to reduce drug use had mixed results, with successful campaigns using messaging on autonomy and achievement of competence, but with others resulting in increased drug use (pointing to the need for careful monitoring and evaluation to mitigate this risk);
  - school-based interventions targeting general drug use were most effective when multiple sessions or booster programs are incorporated; and
  - state-level higher educational institutions in the United States (in states where recreational and medical cannabis has been legalized) adopting a policy of prohibiting the possession and use of cannabis on campus.

QUESTION

Following cannabis legalization in Canada, what are the important health and social outcomes and challenges Canadian youth will likely face, and what approaches to policy and practice should large, student-focused public institutions consider in determining their response to these challenges?

WHY THE ISSUE IS IMPORTANT

With the Canadian government set to introduce legislation in the spring of 2017 to legalize the use of cannabis, there is a need to plan for any health and social challenges associated with this policy change.(1) Though the Task Force on Cannabis Legalization and Regulation has produced a report outlining recommendations for the protection of public health and for minimizing harms, the exact policies and implementation strategies surrounding cannabis legalization remain unknown.(2) Furthermore, these policies may undergo revisions and refinements by provincial and municipal jurisdictions, making the timeframe until cannabis is legally available for public purchase and use unclear. Public institutions, such as colleges and universities, will need to address the health and social consequences of cannabis legalization on students, faculty and staff (e.g., through the creation of new guidelines or programming that targets cannabis users).

Cannabis use is common with approximately 40% of Canadians having used it in their lifetime, and with their first use typically occurring around the age of 18.(3) For youth, in 2016 17.9% of postsecondary students in Canada reported having used cannabis within the last 30 days.(4) As cannabis has been linked with health and social risks, there are concerns that youth may be vulnerable as a result of the federal policy change.(5; 6)

Therefore, identifying the best available research evidence on the health and social outcomes that youth will face, along with potential approaches to address these challenges, will be important steps as student-focused public institutions grapple with future policy change. In this rapid synthesis, which was requested by Arrive and Thrive (http://campusmentalhealth.ca) at McMaster (2015-17), a project led by Dr. Catharine Munn and funded by the Mental Health Innovation Fund, Ministry of Advanced Education and Skills Development. The Arrive and Thrive project focused on developing interventions to prevent and address substance use and to build coping skills among post-secondary students.

Box 1: Background to the rapid synthesis

This rapid synthesis mobilizes both global and local research evidence about a question submitted to the McMaster Health Forum's Rapid Response program. Whenever possible, the rapid synthesis summarizes research evidence drawn from systematic reviews of the research literature and occasionally from single research studies. A systematic review is a summary of studies addressing a clearly formulated question that uses systematic and explicit methods to identify, select and appraise research studies, and to synthesize data from the included studies. The rapid synthesis does <u>not</u> contain recommendations, which would have required the authors to make judgments based on their personal values and preferences.

Rapid syntheses can be requested in a three-, 10- or 30-business-day timeframe. An overview of what can be provided and what cannot be provided in each of these timelines is provided on the McMaster Health Forum's Rapid Response program webpage (www.mcmasterhealthforum.org/policymakers/rapid-response-program)

This rapid synthesis was prepared over a 30-business-day timeframe and involved five steps:
1) submission of a question from a health system policymaker or stakeholder (in this case, the Arrive and Thrive program at McMaster University);
2) identifying, selecting, appraising and synthesizing relevant research evidence about the question;
3) drafting the rapid synthesis in such a way as to present concisely and in accessible language the research evidence; and
4) finalizing the rapid synthesis based on the input of at least two merit reviewers.

WHAT WE FOUND

We identified a total of 44 relevant documents which addressed some aspects of the question, including 16 systematic reviews, 11 narrative reviews, 9 single studies, and eight program and system descriptions/analyses. We provide more details about each systematic review and the single studies in Appendix 1 and 2, respectively. The majority of literature we identified addressed the health and social outcomes and challenges that are associated with cannabis. To provide additional insight into the approaches to policy and practice that student-focused public institutions should consider, we provide an overview of approaches that have been used in other jurisdictions based on what we identified from research evidence, as well as from the program and system descriptions/analyses. Where possible we identify if the research evidence is specific to youth within a Canadian context.

Findings related to the health and social outcomes which Canadian youth will likely face following cannabis legalization

We identified 19 relevant documents regarding the health and social outcomes of cannabis in youth, including two systematic reviews, 11 narrative reviews, and six single studies.

Health outcomes

Canadian survey data reveals that approximately 5-10% of cannabis users develop dependence.(7) For comparison, out of the approximately 22 million Canadians who drink alcohol, about 22% meet the criteria for dependence or abuse at some point in their life.(8)

The effects of cannabis consumption are dose-dependent and vary by frequency of use.(9) While acute cannabis use during pregnancy can negatively affect fetal development, short-term use does not produce fatal overdoses, unless consumed with other toxic substances.(10-12) Long-term use of cannabis, however, can result in a wide array of physical and mental health challenges for regular users, and by extension, public institutions. For example, cannabis-related utilization of healthcare was found to increase after its legalization, which suggests the need for health systems to adjust.(13)

Psychological and mental health outcomes

Chronic cannabis use beginning in adolescence and continuing into adulthood puts users at greater risk of developing cannabis dependence syndrome, cognitive impairment, and neurodevelopmental complications compared to other regular users.(12-15) A medium-quality review found that persistent cannabis use impairs memory and psychomotor functioning, with mixed findings for its effect on planning, reasoning and problem solving.(16) However, many single studies have shown that long-term cannabis use is correlated with cognitive deficits in domains of attention, working memory, learning, concentration, processing speed and executive functioning.(11; 14; 17; 18)

Box 2: Identification, selection and synthesis of research evidence

We identified research evidence (systematic reviews and primary studies) by searching (in February 2017) Medline and Health Systems Evidence (www.healthsystemsevidence.org). In both databases we employed a search strategy of: (marijuana OR cannabis) AND (legalization OR legalisation).

For each review we included in the synthesis, we documented the focus of the review, key findings, last year the literature was searched (as an indicator of how recently it was conducted), methodological quality using the AMSTAR quality appraisal tool (see the Appendix for more detail), and the proportion of the included studies that were conducted in Canada. For primary research (if included), we documented the focus of the study, methods used, a description of the sample, the jurisdiction(s) studied, key features of the intervention, and key findings. We then used this extracted information to develop a synthesis of the key findings from the included reviews and primary studies.

Tetrahydrocannabinol (THC) is an active component in cannabis that binds to cannabinoid receptors expressed in areas of the brain associated with schizophrenia.(10; 15) Cannabinoid intoxication can lead to increased impulsivity and decreased processing speed, attention span, recall abilities, reaction time and psychomotor abilities when used in higher doses.(14; 15; 18-20) In the long-term, use of cannabis may also increase risk of psychosis in patients who are predisposed to psychiatric illnesses, and can worsen the progression of schizophrenia and bipolar disorders.(10; 21; 22) Long-term and frequent cannabis use has also been found to be associated (mixed evidence regarding causality) with personality disorders, anxiety, depression and suicidal ideation in adolescents, despite its legalization being linked to declining rates of suicide among men aged 20-30.(10; 22; 23)

Other components of cannabis including cannabigerol (CBG), cannabinol (CBN), and cannabidiol (CBD), are not psychoactive as compared to THC. CBD has been shown to have anxiolytic, antipsychotic, anti-emetic and anti-inflammatory effects, and may have therapeutic benefits for inflammatory bowel disorder.(15; 24)

Physical health outcomes

Daily cannabis use has been found to be associated with cardiovascular disorders such as heart failure, myocardial infarction and hypertension, although longitudinal studies have yet to establish its relationship with long-term mortality.(10; 25-27) Increased risk of infectious diseases, hepatic disorders, and cancer have also been found in single studies.(10) Smoking cannabis regularly has also been associated with elevated symptoms of chronic bronchitis, pharyngitis, exacerbation of bronchial asthma, and in some cases, respiratory cancers. However there have been conflicting results about whether cannabis can be causally linked to these conditions.(11-13; 15; 17) A low quality systematic review concluded that there was no overall association between cannabis use and head and neck cancer, but did find a possible increased risk of oropharyngeal cancer and lung cancer, and a moderately increased risk of testicular cancer.(28)

A retrospective analysis of 1,215 men in Denmark found that using cannabis more than once per week correlated with a significantly lower sperm concentration and total sperm count compared with non-users, suggesting a possible relationship between cannabis use and male reproductive health.(29)

Social outcomes

The legalization of cannabis may reduce black market sales, youth illegal activity rates, and unsafe environments for cannabis use, and shift power away from sellers of contraband cannabis.(13) In some areas, the legalization of cannabis has been linked to increased cannabis use, earlier use and increased social acceptability, and reduced perceived risk.(12; 13; 30)

Increased use of cannabis following legalization

In the United States, single studies have compared cannabis use between states that allowed and prohibited the use of medical marijuana, and found higher rates of cannabis use in states that allow medical marijuana use, although a causal relationship was not established.(12; 30) In similar studies that accounted for differences in pre-legalization rates of cannabis use, no significant difference was found in rates of change of cannabis use, or perceived risks of cannabis use between states that did and did not allow medical marijuana.(12) The review reported mixed results because another included study found decreased perceived risk of cannabis use, increased ease of access, use and dependence following commercialization of medical cannabis in Colorado.(12) Another cross-sectional study found a significantly positive correlation between cannabis legalization, increased levels of perceived risk, and negative consequences.(31) Overall, the heterogeneous findings suggest that the recreational use of cannabis may increase following its legalization, but it is difficult to predict the direction, magnitude and consequences across Canada.

Other outcomes

Cannabis is commonly thought to be a 'gateway drug,' since early cannabis use has been correlated with subsequent illicit drug use, although a causal relationship has not yet been identified as many of these findings originate from retrospective studies.(13; 30; 32) However, chronic use of cannabis has been correlated with lower academic achievement, job performance, and social functioning in relationships, while acute cannabis use has been shown to impair driving ability.(14; 17) Persistent cannabis has also been tied to downward social class movement, with a dose-dependent relationship with regards to financial challenges.(33)

States in which cannabis has been legalized also suffer from more cases of cannabis-related fatalities due to accidental cannabis exposure to infants, and impaired decision-making when intoxicated.(13; 34) In addition, after Colorado legalized cannabis there was an increase in emergency room visits for cannabis intoxication, cannabis-related burns and cyclic vomiting syndrome.(35) These jurisdictions also had increased motor vehicle collisions due to intoxication, and have set intoxication limits to protect their citizens.(12; 13; 30)

Findings related to the approaches to policy and practice which large public institutions may consider following cannabis legalization

We identified 14 systematic reviews (36-49) focused on interventions for preventing, reducing or managing substance use, with eight (37; 40; 42; 43; 46-49) focused specifically on addressing cannabis use. We also identified three single studies, and eight program and system descriptions/analyses.

Cannabis use

A medium-quality review identified 25 instruments that were specific to screening and assessing cannabis use disorders. Overall, the instruments had good psychometric qualities, however, the existing instruments had limitations for use in clinical practice (e.g., time constraints and lack of validity for use with some populations). Instruments that performed well included the Cannabis Abuse Screening Test, Cannabis Use Disorder Identification Test, Drug Use Disorder Identification Test, and Alcohol, Smoking, and Substance Involvement Screening Test. The authors indicate that screening instruments must be used for populations in which they have been tested, and new strategies for identifying the frequency and amount of cannabis use are needed.(49) We did not identify any systematic reviews that examined the effectiveness of screening tools. However single studies point to an increase in the detection of health-risk behaviours and a decrease in illicit drug use.(50)

Another medium-quality review identified interventions designed to reduce adolescent cannabis use. The interventions that had a large effect size in reducing use included:
- integrated family and cognitive behaviour therapy (i.e., integration of four models: rational emotive therapy, problem-solving therapy, learning strategy training and family therapy);
- multi-dimensional family therapy (i.e., integrated therapy targeted at adolescents, parents, and the interactions they have with each other and society);
- teaching family (i.e., self-government, motivation, relationship development, and youth advocacy skill teaching for parents);
- motivational interviewing (i.e., developing internal motivation for changing behaviour); and
- cognitive behavioural treatment (i.e., identifying and changing maladaptive perceptions that lead to problematic behaviour).

Individual and family-based interventions were shown to have a similar effect in reducing cannabis use, and the authors suggest that clinicians should also consider external factors such as the preference of clients, their families and the treatment setting.(37)

In addition, three high-quality reviews specifically focused on psychological and/or psychosocial interventions for reducing cannabis use.(40; 42; 46) The most consistently studied interventions across the

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three reviews were cognitive behavioural therapy (CBT), motivational interventions (MET), and contingency management (i.e., voucher incentives for a reduction in cannabis use). All reviews support the effectiveness of CBT and MET, however, it is not clear if CBT is more effective than MET.(40; 42; 46) Contingency management provided alone may be successful in reducing cannabis use in the short term, however, great effects have been found when combined with CBT and/or MET to enhance these treatments.(40; 42; 46) Key features of successful interventions may include high-intensity and long-term (i.e., delivered longer than one month) interventions.(46) One medium-quality review also focused specifically on psychological and/or psychosocial interventions for reducing cannabis use, and found that younger participants were more likely to have a larger reduction in use following the intervention.(43)

Another high-quality review examined digital interventions (i.e., based on communication and/or information technologies) to target cannabis users who may not make contact with traditional treatment systems.(48) All of the interventions in the review were web-based, and used CBT, MET or a combination of them. A small effect was found for reducing cannabis use through digitally delivered CBT and MET. The largest effect was found for a web-based online chat with a trained psychotherapist, personal diary and written feedback based on CBT/MET. Given these findings, the authors suggest that digital interventions are versatile and can be delivered through various channels, including email, online or mobile advertisements, or mobile applications.(48)

Another high-quality review found that school-based, peer-led interventions reduced cannabis use in adolescents. The interventions were heterogeneous, however several used the social influence model to build curriculum, which addressed factors such as pressure, awareness of advertising and resistance skills. Though the review was not targeted to cannabis use, this was the only illicit drug that the included studies focused on. Interventions that were longer or included booster sessions were more effective, suggesting that messaging must be sustained to have an impact on behaviour.(47)

General drug use

Four reviews examined school-based interventions for reducing or preventing substance use in adolescents.(38; 44) One high-quality review found that brief interventions (i.e., targeted, time-limited services) had the same effect as information provision. There was limited evidence to suggest that brief interventions could reduce cannabis use in particular, and the authors concluded that the effectiveness of brief interventions is questionable.(38) Another high-quality review examined social-competence (i.e., drug use is learned from modelling, imitation and reinforcement) and social-influence (i.e., drug use is a result of external pressures) approaches to reduce the use and intention to use drugs among children and youth in primary or secondary school. Social-competence approaches (e.g., goal-setting, problem-solving, decision-making, and cognitive skills to enhance self-esteem, cope with stress and increase assertiveness), were the most represented in the literature, and while these interventions have been found to reduce drug use, the effects were largely insignificant. In addition, among these interventions, social influence approaches had weaker effects. The largest effects were seen when the approaches were combined.(44)

The other two reviews were of medium quality and examined universal school-based interventions (i.e., those delivered to all students regardless of risk).(39; 45) One review that evaluated various intervention models found that the model, which included resistance and social skills to improve self-esteem, decision-making, and communication, showed significant effects at final follow-up. Among alcohol, tobacco and cannabis, the interventions only had a significant effect in reducing cannabis use.(45) The other review examined universal interventions delivered specifically through computer or internet-based programs. Most of the interventions were based on social-influence theory, and there were slight reductions found in alcohol and tobacco use, and a significant reduction in cannabis use. A key feature of successful interventions was the inclusion of multiple sessions, with booster programs available if needed.(39)

Lastly, a high-quality review found mixed evidence for the effectiveness of mass-media campaigns on drug use. There were no key features of campaigns that appeared to influence their success. However, two

campaigns that were successful used focused messaging on autonomy and achievement of competence. Some campaigns increased drug use, and the authors suggest that any media campaign should be monitored and evaluated in the field to mitigate this risk.(36)

In an overview of systematic reviews, policy-level interventions for reducing smoking/tobacco use were identified.(41) The effectiveness of tobacco-cessation advertising and promotion, school policies to prevent smoking, and restricting access ranged from harmful (advertising increased likelihood of youth smoking) to non-significant.

Implementation considerations

We also identified two single studies (51; 52) which identify potential implementation considerations for cannabis-related interventions. Both studies were conducted in the United States (Colorado and California) and included youth and/or adolescents. One study found that cannabis users who increased use over time had more psychiatric challenges. However they were less likely to receive psychiatry services as compared to a population that abstains from cannabis and has fewer psychiatric challenges. This may point to barriers to care for the heaviest users of cannabis.(52) In the other study, males were less likely to perceive a high-to-moderate risk of using cannabis daily. Furthermore, only 30% of adolescents surveyed indicated a medical provider had discussed cannabis with them.(51)

As we identified limited research evidence regarding a systems or policy approach that student-focused public institutions could take, we provide an overview of examples from other jurisdictions where recreational and medical cannabis has been legalized, including Alaska, California, Colorado, Maine, Massachusetts, Nevada, Oregon and Washington. In reviewing the policies of eight state-level higher educational institutions (University of Alaska Anchorage, University of California, University of Colorado, University of Massachusetts, University of Nevada, Washington State University and Oregon State University), we found that all prohibit the possession and use of cannabis on campus or university property.(53-60) In addition, four universities (University of Colorado, University of Maine, University of Massachusetts and University of Nevada) include a prohibition on possession and use of medical marijuana on campus.(55-58) The University of Nevada also indicates that students may request to be released from the university housing agreement if they wish to use medical marijuana.(58) Unfortunately, we did not identify any evaluations of the impact of these approaches.

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APPENDICES

The following tables provide detailed information about the systematic reviews and primary studies identified in the rapid synthesis. The ensuing information was extracted from the following sources:

- systematic reviews - the focus of the review, key findings, last year the literature was searched and the proportion of studies conducted in Canada; and
- primary studies - the focus of the study, methods used, study sample, jurisdiction studied, key features of the intervention and the study findings (based on the outcomes reported in the study).

For the appendix table providing details about the systematic reviews, the fourth column presents a rating of the overall quality of each review. The quality of each review has been assessed using AMSTAR (A MeaSurement Tool to Assess Reviews), which rates overall quality on a scale of 0 to 11, where 11/11 represents a review of the highest quality. It is important to note that the AMSTAR tool was developed to assess reviews focused on clinical interventions, so not all criteria apply to systematic reviews pertaining to delivery, financial, or governance arrangements within health systems. Where the denominator is not 11, an aspect of the tool was considered not relevant by the raters. In comparing ratings, it is therefore important to keep both parts of the score (i.e., the numerator and denominator) in mind. For example, a review that scores 8/8 is generally of comparable quality to a review scoring 11/11; both ratings are considered "high scores." A high score signals that readers of the review can have a high level of confidence in its findings. A low score, on the other hand, does not mean that the review should be discarded, merely that less confidence can be placed in its findings and that the review needs to be examined closely to identify its limitations. (Lewin S, Oxman AD, Lavis JN, Fretheim A. SUPPORT Tools for evidence-informed health Policymaking (STP): 8. Deciding how much confidence to place in a systematic review. *Health Research Policy and Systems* 2009; 7 (Suppl1):S8).

All of the information provided in the appendix tables was taken into account by the authors in describing the findings in the rapid synthesis.

Appendix 1: Summary of findings from systematic reviews about [health and social outcomes/policy or program approaches]

Focus of systematic review	Key findings	Year of last search/ publication date	AMSTAR (quality) rating	Proportion of studies that were conducted in Canada
Mass-media campaigns effectiveness in preventing drug use (36)	The review examines the effectiveness of mass-media campaigns in preventing or reducing the use of illicit drugs. Studies were included if participants were under the age of 26, and evaluated mass-media campaigns targeted at illicit drug use. A total of 24 papers corresponding to 19 individual studies were included. The majority of the 184,811 participants were 10 to 19 years old. The pooled analysis of five randomized controlled trials (RCT) showed no effect of mass-media campaigns on drug use. One mixed RCT-cohort study showed that a media community intervention was effective at reducing drug use. The Office of National Drug Control Policy (ONDCP) National Youth Anti-Drug Media Campaign was found to increase drug use in two studies. A new version of the same campaign was found to reduce marijuana use among girls in Grade 8. The findings of the included studies differed between the type of intervention and the study design. There were no core features of the campaigns that determined their success. Both campaigns that showed effectiveness included messaging around autonomy and achievement of competence. The intervention which increased drug use was based on resistance skills, self-efficacy, normative education and the negative consequences of drug use. The authors concluded that any mass-media campaign should be evaluated in the field, as they may be ineffective or harmful.	2013	8/11 (AMSTAR rating from the McMaster Health Forum)	1/19
Interventions to reduce adolescent cannabis use (37)	The review and meta-analysis examines the effectiveness of interventions aimed at reducing cannabis use in adolescents. A total of 15 RCTs were included, analyzing interventions used in the United States between 1960 and 1980. Pooled effects suggest that interventions to reduce cannabis use have a medium effect. The effects of multi-dimensional family therapy showed a large reduction in cannabis use. The authors suggest that engaging family, school, peers and other service providers show promise in reducing cannabis use, and this can also increase retention rates. Individual treatments, specifically motivational interviewing, also demonstrated a large effect size. Subgroup analysis revealed that individual and family-based interventions had comparable effect sizes. The authors conclude that there is not enough evidence to determine the most effective treatment, and clinicians should choose treatments based on evidence and external factors, including the fit for the individual, family and the treatment setting.	2008	7/11 (AMSTAR rating from the McMaster Health Forum)	0/15
Effects of cannabis on driving (34)	The narrative review examines cannabis' effect on driving. Ten epidemiologic studies from six countries have examined the relationship between cannabis use and motor vehicle accidents (MVA). Frequent cannabis exposure (i.e., greater than four days/week) was associated with a higher risk for MVA. Two meta-analyses showed an increased MVA risk after cannabis use. In three experimental studies, participants who had used cannabis performed worse on divided-attention tasks, during unexpected circumstances and choices, and during long, monotonous drives. Four out of six driving-simulator studies showed that THC ingestion increased reaction time. A case control study found that over 40% of 681 THC-positive drivers involved in fatal crashes had a blood-alcohol level above the legal limit. One study showed that alcohol plus a high THC dose increased reaction time by 36%. In regards to the perception of driving under the influence of cannabis (DUIC), one fourth of 320 drivers who had smoked cannabis in the previous year reported a greater than 90% likelihood of DUIC, even after receiving information about the increased crash risks.	n/a	n/a	n/a

Focus of systematic review	Key findings	Year of last search/ publication date	AMSTAR (quality) rating	Proportion of studies that were conducted in Canada
Acute and chronic effects of cannabinoids on cognition (16)	The review examined the acute and chronic effects of cannabis use on neuropsychological task-based measures of cognition. The 105 studies included in the qualitative synthesis showed that the most common cognitive domain affected by cannabis use is memory. Verbal learning and memory is delayed in cannabis users, with long-term users being more affected than short-term users. It is unclear if working memory is affected by cannabis use, due to the variety of working memory tasks that are studied. Generally, impaired working memory resolves with a longer period of abstinence. Acute exposure to cannabis impairs focused, divided and sustained attention. In regards to long-term use, attention gradually improves over time. Psychomotor function is impaired after both acute and long-term cannabis use. There are mixed findings for the effects of cannabis on planning, reasoning, inference control and problem-solving. There is some evidence to suggest that acute cannabis use impairs decision-making. The author concludes that cognitive impairment persists after the acute intoxication, and may potentially affect educational and psychosocial outcomes, particularly in youth.	2015	5/10 (AMSTAR rating from the McMaster Health Forum)	Not reported
School-based interventions and behavioural outcomes for substance-using adolescents (38)	The review examines the effectiveness of brief school-based interventions on reducing substance use and behavioral outcomes in adolescents, compared to other interventions or assessment-only conditions. Six studies involving 1,139 participants were included. The quality of the included studies was moderate for the information-provision comparison, and low or very low for the assessment comparison. A brief intervention is defined as a targeted, time-limited service. They are most often delivered in-person and involve information provision, motivational techniques, and teaching behavioural change skills. Compared to information provision, brief interventions did not have a significant effect on substance use. When compared with assessment-only controls, brief interventions did have a significant effect on substance use and delinquent behaviour. There was some evidence to suggest the brief interventions could reduce cannabis use in particular. The authors conclude that they are unable to make a statement regarding the effectiveness of brief interventions.	2015	10/10 (AMSTAR rating from the McMaster Health Forum)	0/6
School-based alcohol and other drug prevention programs (39)	The review examines the current school-based alcohol and other drug prevention programs facilitated by computers or the internet. There were 12 trials of 10 programs included. The majority of the trials were conducted in Australia or the United States and targeted students aged 13-to-15 years old. All of the interventions were universal (i.e., delivered regardless of risk), and most were based on social-influence theory. Social-influence theory states that young people use drugs as a result of external pressure. The approach uses information provision, resistance skills and normative education. The quality of the included studies overall was weak. Five trials targeted tobacco and showed a slight reduction in smoking. Four trials which targeted alcohol consumption found a slight reduction in alcohol use. One of the trials targeted marijuana use and found a significant reduction in the frequency of use after six months of follow-up. The authors suggest that internet programs increase accessibility, and based on the current results, they appear to be a promising framework for the provision of school-based prevention interventions. A key feature of the successful interventions was multiple (four to 12) sessions and booster lessons. A limitation of the review was that students self-reported. Furthermore there were a small number of studies included.	2012	5/10	1/14

Focus of systematic review	Key findings	Year of last search/ publication date	AMSTAR (quality) rating	Proportion of studies that were conducted in Canada
Psychological and psychosocial interventions for cannabis cessation (40)	The review examines the clinical effectiveness of psychological and psychosocial interventions for cannabis cessation in adults who use regularly. The review included 33 RCTs, mainly from the United States and Australia. The mean age of participants was 29 years. A total of 26 studies examined the general population of cannabis users (7,643 participants). Six of these studies assessed the effects of cognitive behavioural therapy (CBT) as compared to those on a wait list. CBT was found to be significantly more effective than wait list on cannabis use, severity of dependence, and cannabis problems. Four studies examined CBT against motivational interviewing and found mixed results. Three studies examined telephone-delivered CBT, internet-delivered CBT, and internet counselling, and all showed significant improvements over wait list or educational interventions. Seven studies examined cannabis users with psychiatric conditions (525 participants). Four of these assessed CBT plus treatment as usual (TAU) compared with TAU alone. There were few significant differences between groups found in relation to cannabis outcomes. Key features of successful interventions included longer courses of CBT and individual treatment (slight advantage found with limited data). The authors cite a high risk of bias in the included studies, and conclusions should be interpreted with caution.	2014	10/10 (AMSTAR rating from the McMaster Health Forum)	2/33
Interventions for adolescent substance abuse (41)	The overview of systematic review examines effectiveness of substance abuse interventions for adolescents and delivery platforms. A total of 46 reviews were included and classified as interventions for smoking/tobacco use, for alcohol use, for drug use, and targeting combined substance abuse. Twenty reviews focused on smoking/tobacco use. The AMSTAR quality rating for the included reviews ranged between five and 10 (moderate to high quality). One review found that school smoking interventions for prevention, combined with social-competence and social-influence curricula have a significant effect. Three reviews examined family- and community-based interventions and found that both programs reduced smoking rates. With regards to delivery, a review found that anti-tobacco mass-media campaigns can be effective, and internet-based interventions showed mixed results. Eight systematic reviews reported on interventions for alcohol use. The AMSTAR rating for these reviews ranged between seven and 10 (moderate to high). Four reviews found that school-based interventions for alcohol use were effective to some degree. Key features may include personalized feedback, moderation strategies and goal-setting. One review found that family-based prevention programs are generally effective, and effects may persist over the medium to long term. Digital intervention platforms were found to be as effective as other alcohol interventions. There is some evidence to suggest multi-component interventions are effective, but little to suggest they are better than single-component interventions. Two reviews examined interventions to reduce drug use. The AMSTAR rating ranged from 8 to 10 (high). One review found that social-influence and social-competent approaches when combined reduced marijuana use. Programs that incorporated several prevention models were more effective than those based on only social influence. Longer programs (greater than 15 sessions) were more effective than shorter interventions.	2015	8/10 (AMSTAR rating from the McMaster Health Forum)	Not reported

Focus of systematic review	Key findings	Year of last search/ publication date	AMSTAR (quality) rating	Proportion of studies that were conducted in Canada
	Sixteen reviews examined combined drug use interventions. The AMSTAR rating for these reviews ranged from 6 to 10 (moderate to high). Four reviews found that school-based interventions that promote a positive school ethos and reduce student disaffection were effective. Brief interventions (BIs) reduced cannabis use frequency, alcohol use, alcohol abuse and dependence, and cannabis abuse. BIs were not more effective than information provision alone. Key features of effective school programs include long-term interventions and comprehensive programs that have anti-drug information combined with refusal, self-management and social-skills training. One review suggests that the most effective family and community interventions are those that emphasize parental involvement and developing skills, such as social competence, self-regulation and parenting.			
Psycho-therapeutic interventions for cannabis use disorder (46)	The review examines the efficacy of psychosocial interventions for cannabis use disorder in adults, in an outpatient or community setting. Twenty-three RCTs, involving 4,045 participants were included. The studies took place in the United States (n=15), Australia (n=2), Germany (n=2), Switzerland (n=1), Canada (n=1), Brazil (n=1) and Ireland (n=1). The overall risk of bias across studies was moderate. Cognitive behavioral therapy (CBT), motivational enhancement therapy (MET), and their combination, were the most consistently cited therapies. These interventions were found to reduce cannabis use frequency and the severity of dependence. Voucher-based incentives were supported in five out of six studies. There was limited evidence found to support the effectiveness of drug counselling, social support, relapse prevention and mindfulness meditation. The review was limited as included participants were generally Caucasian males in their late 20s or early 30s. Furthermore few trials were conducted outside of the U.S., limiting the generalizability.	2015	10/11 (AMSTAR rating from the McMaster Health Forum)	1/23
Screening and diagnostic instruments for cannabis use disorders (49)	The review examines the instruments used to screen and assess cannabis use disorders. A total of 34 studies and 25 instruments were included in the review, falling into the categories of specific scales for assessing cannabis use disorders, scales for assessing drug use disorders, structured interviews, and tools for quantifying cannabis use. The instruments with the best performance were the Cannabis Abuse Screening Test (CAST), Cannabis Use Disorder Identification Test (CUDIT), Drug Use Disorder Identification Test (DUDIT) and Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST). The CAST is designed to test cannabis use in the past month in 18-25-year-olds, and has good content validity when the gold standard was DSM-IV criteria or urine sampling. The CUDIT was tested in adolescents and young adults and has high validity when the gold standard was the Structured Clinical Interview for DSM-IV. The DUDIT was tested in adult populations and shows high sensitivity and specificity. The ASSIST was developed by the World Health Organization for use in primary-care settings in adult populations. It shows high internal consistency, but low test-retest reliability. Most of the instruments had good psychometric properties, however there were limitations including the length of time required to use the instrument (this was the case for all of the included structured interviews, and several of the scales). Instruments to quantify consumption do not show the amount of psycho-active substance per unit of consumption. This is challenging, as the THC concentration is not standardized across regions. The authors conclude that the existing instruments for assessing cannabis use need to be improved.	2013	4/10 (AMSTAR rating from the McMaster Health Forum)	Not reported

Focus of systematic review	Key findings	Year of last search/ publication date	AMSTAR (quality) rating	Proportion of studies that were conducted in Canada
Psychosocial interventions for substance abuse disorders (43)	The review examines the efficacy of psychosocial treatments for substance use disorders. Thirty-four RCTs were included with a total of 2,430 participants. Psychosocial interventions had highest efficacy for cannabis use compared to polysubstance, cocaine, and opiates use. Contingency management demonstrated the lowest dropout rates (29.4%), followed by general cognitive behaviour therapy (35.3%) and cognitive behaviour therapy plus contingency management (44.5%). A significant negative correlation was found between age and effect size (r=–0.37, p<0.05), suggesting that younger samples were more likely to have larger effect sizes. A significant negative correlation was also found between average years of substance use and treatment dropout rate (r= –0.68, p<0.05).	2005	5/11 (AMSTAR rating from the McMaster Health Forum)	0 /34
Effectiveness of school-based interventions in preventing or reducing drug use (44)	The review examines the effectiveness of school-based interventions to improve knowledge, developing skills, promoting change and preventing or reducing drug use. Twenty-nine RCTs and three case controlled trials were included in the review. Skills-focused programs appear to have a positive effect on both mediating variables (drug knowledge, decision making, self-esteem and peer pressure resistance) and final outcomes, compared to usual curricula. The pooled estimates showed a statistically significant 20% reduction of marijuana use in the intervention groups at the post-test, and 55% of hard drugs use. Affective-focused programs improve decision-making skills and drug knowledge compared to both usual curricula and knowledge-focused interventions, but no evidence of effectiveness is shown for prevention of drug use. Knowledge-focused programs improve mediating variables (especially drug knowledge) compared with usual curricula, but are not more effective than skills-based programs, and are less effective than affective programs. When final outcomes are considered (drug use), their effects are comparable to those of the usual curricula, not different from resistance training programs, and less effective than normative education programs.	2004	9/11 (AMSTAR rating from the McMaster Health Forum)	0/28
Middle school-based drug abuse prevention programs (45)	The review examines the effectiveness of universal, middle school-based drug-abuse prevention curricula. Thirteen articles were included in the review, including six RCTs of four distinct school-based curricula. Of 42 drug measure outcomes, only three showed significant differences between the interventions and control groups, however one was an iatrogenic effect (i.e., an increased in cannabis use among participants in the interventions group). The authors conclude that the iatrogenic effect was most likely due to chance, as a number of statistical tests were performed. The model that included resistance and social skills to improve self-esteem, decision-making, and communication, showed significant effects at final follow-up. Among alcohol, tobacco and cannabis, the interventions only had a significant effect in reducing cannabis use. Overall, the authors concluded that universal, school-based drug prevention curricula are not effective in reducing drug and alcohol use. Though specific interventions (no key features are apparent) may prevent specific types of drug use in specific populations.	2015	5/10 (AMSTAR rating from the McMaster Health Forum)	0/13
The association between marijuana use and cancer risk (28)	The review examines the epidemiologic studies on the association between cannabis use and cancer risk. Four cohort studies and 30 case-control studies were included in the review. No overall association was found between head and neck cancer and use of cannabis. Use of cannabis is associated with a possible increased risk with dose-response for oropharyngeal cancer and a decreased risk for oral tongue cancers. Use of cannabis is associated with a potential increase in risk for lung cancer, mainly in combination with smoking tobacco, and cigarette smoking. Cannabis use is	2014	3/9 (AMSTAR rating from the McMaster	6/34

Focus of systematic review	Key findings	Year of last search/ publication date	AMSTAR (quality) rating	Proportion of studies that were conducted in Canada
	moderately associated with testicular cancer risk. Insufficient data was collected to assess the association between cannabis use and childhood cancer and bladder cancer.		Health Forum)	
Digital interventions for reducing problematic cannabis use in non-clinical settings (48)	This review examines the effectiveness of digital interventions for reducing cannabis use in non-clinical settings. Four RCTs were included in the review, totalling 1,928 participants. All of the included interventions were web-based and used MET and CBT delivered online. The results from the meta-analysis showed a small effect size for the interventions on reductions in cannabis use. The authors conclude that web- and computer-based interventions can be effective at reducing cannabis use. The largest treatment effects were found for the web-based online chat with a trained psychotherapist, plus online diary with weekly personalized, written feedback based on CBT/MET. Since few problematic cannabis users access the conventional addiction treatment system, digital interventions have the potential to reach this population of adolescents and young adults.	2015	9/11 (AMSTAR rating from the McMaster Health Forum)	0/4
Peer-led interventions to prevent tobacco, alcohol, and other drug use among young people (47)	This review examines the effect of peer-led interventions to prevent tobacco, alcohol, and other drug use among young people 11-21 years old. Seventeen studies were included, with ten relating to tobacco smoking, six related to alcohol, and three related to cannabis use. The meta-analysis determined that the odds of smoking were lower among those receiving the peer-led intervention compared with control [odds ratio (OR) = 0.78, 95% confidence interval (CI) = 0.62-0.99, P = 0.040]. Three studies (n = 976 students in 38 schools) suggested an association with lower odds of cannabis use (OR = 0.70, 0.50-0.97, P = 0.034). While the meta-analysis found overall benefits for the interventions, two studies showed that peer-led interventions can increase tobacco or alcohol use among high-risk groups. These interventions identified peer leaders via social network nominations and used small-group discussion and role-play with the peer leader. Interventions that were longer or included booster sessions were more effective, suggesting that messaging must be sustained to have an impact on behaviour.	2015	11/11 (AMSTAR rating from the McMaster Health Forum)	0/17

Appendix 2: Summary of findings from primary studies about health and social outcomes/policy or program approaches

Focus of study	Study characteristics	Sample description	Key features of the intervention(s)	Key findings
Association between cannabis use and blood pressure (27)	*Publication date:* 2016 *Jurisdiction studied:* USA *Methods used:* Cross-sectional design	Community residents in the United States. Population included adults aged 20-59.	n/a	There is a modest association between recent cannabis used and increased systolic blood pressure. There was no association between a lifetime of cannabis use and blood pressure levels.
Impact of marijuana policy on youth (61)	*Publication date:* 2015 *Jurisdiction studied:* USA *Methods used:* n/a (technical report)	n/a	n/a	Common side effects of cannabis use are increased heart rate and systolic blood pressure. Use may lead to several causes of anxiety symptoms or panic attacks. It is suggested that the developing adolescent brain is at risk for the development of substance abuse disorders. Youth who use cannabis regularly perform more poorly on working memory, visual scanning, cognitive flexibility and learning tests. Examining the high school data (from 14 states) before and after medical marijuana legalization shows that there is an increase in recreational use. The use of cannabis in the Netherlands increased slightly after legalization.
Medical marijuana and suicides (23)	*Publication date:* 2014 *Jurisdiction studied:* USA *Methods used:* Cross-sectional design	Participants aged 15 years and older from 1990-2007	n/a	Male suicide rates declined in states that enacted medical marijuana laws, while in control states (those without medical marijuana laws) rates remained constant. Female suicide rates also decreased after the laws were enacted, however the control states had a similar trajectory.
Effect of marijuana use on impulsivity and hostility in daily life (19)	*Publication date:* 2015 *Jurisdiction studied:* USA *Methods used:* Uncontrolled cohort	43 participants with a mean age of 23.7 years who reported previous recreational marijuana use, consumed alcohol at least once per week, and were not substance dependent	n/a	Marijuana use was associated with increased impulsivity on the day of use, after accounting for other variables. Use also increased impulsivity on the next day. Marijuana use was associated with an increase in one's own hostile behaviour on the day of use. Any marijuana use, independent of alcohol use, was associated with increased impulsivity and hostility on the same day.
Student attitudes and perceived risk of cannabis use (62)	*Publication date:* 2016 *Jurisdiction studied:* Ireland *Methods used:* Descriptive cross-sectional design	Public and private secondary school, including 549 students aged 15-18	n/a	The majority of respondents (84.8%) reported that they personally knew someone who had used cannabis in the past, and 39.9% had personally used cannabis. Males were more likely to believe that the drug is safe to consume. Only 26.1% of respondents perceived using marijuana as a great risk to mental or physical health. Those who had previously used the drug were more likely to perceive a lower risk in general.
Role of the tobacco industry in marijuana legalization (63)	*Publication date:* 2014 *Jurisdiction studied:* USA *Methods used:* Snowball research technique	Legacy Tobacco Documents Library	n/a	Beginning in 1969 the tobacco industry began to display an interest in marijuana smoking devices. Tobacco companies were monitoring marijuana research, and several began researching product competition and forecasting for possible marijuana legalization. The author argues that tobacco companies, with their marketing power and engineering capacity, may take over marijuana markets and cause another public health problem. The author also suggests that learning from tobacco control, smoking marijuana should not be allowed in places where smoking cigarettes is not allowed.

Focus of study	Study characteristics	Sample description	Key features of the intervention(s)	Key findings
Legalization of cannabis and different administration methods (58)	*Publication date:* 2016 *Jurisdiction studied:* USA *Methods used:* Observational design	A survey was administered through paid advertising on Facebook, targeting an audience of cannabis users, with a mean age of survey respondents of 32.5 years	n/a	A total of 2,838 individuals completed the survey. The use of cannabis via vaping or edibles was significantly high in medical marijuana law (MML) states. Respondents in non-MML states were more likely to prefer smoking than those in MML states. The authors suggest that vaping has become increasingly popular in recent years. There is a possibility of selection bias as the respondents reflect a convenience sample.
Awareness, perception of risk and behaviours related to marijuana use in youth (51)	*Publication date:* 2017 *Jurisdiction studied:* USA *Methods used:* Epidemiologic survey	241 youth aged 13-to-18 years in Colorado, with 63% male sample	n/a	Youth generally understood marijuana laws; 68% could identify the laws related to legal age, 70% knew outdoor smoking was not permitted and 74% knew that one could get a DUI. Forty per cent of youth had perceived a moderate to high risk among teens who used weekly, and 57% perceived moderate to high risk when teens used daily. Forty per cent of youth responded that most or all of their friends use marijuana. Only 30% indicated a medical provider had discussed marijuana with them. Young men, African-American and Latino respondents were less likely to perceive risks of cannabis use.
Marijuana use and health service utilization in adolescents (52)	*Publication date:* 2016 *Jurisdiction studied:* USA *Methods used:* Cohort design	419 adolescents aged 13 to 17 who entered a substance use treatment program and who may have used alcohol and/or drugs not limited to marijuana	A one-year program of abstinence-based, intensive, structured outpatient treatments, with regular breathalyzer and urine screens. The program required parents or guardian participation and provided group therapy, education, and relapse prevention. Family therapy and individual counselling were available as needed.	Those who abstained scored lower on externalizing and anxiety/depression scores than those who used low (five days/months) or high (25 days/month) amounts of cannabis. The abstinence group had lower use of psychiatric and substance use treatment services over time. There was an increasing trend in emergency department use for the abstinence group. Though participants who used cannabis were more likely to experience psychiatric problems, they were not more likely to use health services. The authors suggest that there may be barriers to accessing care for cannabis users.
Cannabis and alcohol dependence and mid-life economic and social problems (33)	*Publication date:* 2016 *Jurisdiction studied:* New Zealand *Methods used:* Longitudinal study	Participants were drawn from the Dunedin Multidisciplinary Health and Development Study, which represents a birth cohort of consecutive births between April 1972 and March 1973. The cohort included 1,073 children, representing the full range of socio-economic status in New Zealand.	n/a	Persistent cannabis users experienced downward social-class mobility even after controlling for sex, ethnicity, family substance-dependence history, childhood self-control, childhood IQ, history of psychopathology, achievement orientation, and adult family structure. Those who did not use cannabis rose to a higher social class than their parents. Persistent cannabis users also experienced more financial difficulties, engaged in antisocial behaviours at work and reported more relationship conflict. Participants who were dependent on cannabis were more likely to be dependent on alcohol and hard drugs. Having a marijuana-related convictions record, using marijuana at an early age and having a co-occurrence of alcohol or hard-drug dependence did not explain the economic and social problems of persistent cannabis users. Among participants who had completed secondary school, persistent users were less likely to obtain a tertiary degree. The review found a dose-dependent relationship - the more years of

Focus of study	Study characteristics	Sample description	Key features of the intervention(s)	Key findings
				cannabis use, the worse the social and economic challenges. The study took place in a setting where cannabis use is illegal, and it is not clear if the results can be generalized to other settings. However a study in Amsterdam (where cannabis is quasi-legal) found that cannabis use was associated with lower wages among male workers. The authors conclude that persistent cannabis users place a burden on families, communities and national social-welfare systems. Prevention and early treatment is suggested as a way to mitigate these challenges.
Substance use in relation to gambling outcomes in older adolescents and young adults (20)	*Publication date:* 2016 *Jurisdiction studied:* USA *Methods used:* Epidemiologic survey	College students were randomly chosen from the entire student body, and 8,769 participants completed the original survey. Those between 17 and 24 years old who reported gambling in the past six months were selected for analysis.	n/a	Those who reported using alcohol and cannabis before gambling had greater losses, more gambling occasion, more gambling-related consequences, and greater gambling problem severity. Using only cannabis was no different than using both alcohol and cannabis. Since the sample was limited to college-attending older adolescents who reported gambling, the results may not be generalizable to the general population.
Prevalence of marijuana use disorder symptoms (9)	*Publication date:* 2017 *Jurisdiction studied:* USA *Methods used:* National Survey of Drug Use and Help, logistic regression analyses	Ages 12-21, N=9697, 49% female and 63% White	Examine relationship between frequency of marijuana use and likelihood of marijuana use disorder symptoms across different sociodemographic groups Groups: age (dichotomized into 2 categories, 12–15 years old and 16–21 years old), gender, and race/ethnicity (categorized into binary variables, White, Black, and Hispanic/Latino)	Frequency of marijuana use was significantly associated with higher rates of each symptom, while less frequent use was associated with lower rates. Younger age, frequency in marijuana use, past illicit substance abuse in the past year, are associated with higher prevalence of some marijuana use disorder symptoms. For younger adolescents, cut-down was the only statistically significant symptom associated with increased marijuana use. Authors noted that the quantity of marijuana was not recorded, which may be a limitation.
Cannabis use and the risk of psychosis (10)	*Publication date:* 2004 *Jurisdiction studied:* Switzerland *Methods used:* Narrative review	India, New Zealand, Germany	n/a	THC is an active component in cannabis which along with its metabolite (11-OH-THC), binds to receptors expressed in areas of the brain related to the development of schizophrenia. High doses of cannabis can be followed by reversible toxic psychosis (can be severe). Use of cannabis may increase risk of psychosis (more likely in those who have a history of or are predisposed to psychiatric illness), and worsen progression of schizophrenia. Young age may be a risk factor for development of psychoses concurrent with cannabis use.
Non-medical marijuana and the	*Publication date:* 2014	n/a	n/a	Brisk increase in sale of marijuana once legalized, especially in edible forms. Public may have difficulty portioning/rationing doses of edible marijuana.

Focus of study	Study characteristics	Sample description	Key features of the intervention(s)	Key findings
health, policy socioeconomic and nursing implications (30)	*Jurisdiction studied:* Colorado, USA *Methods used:* Narrative review			Use of marijuana is associated with cardiac, pulmonary, hepatic, and vascular disorders and elevated risks for infectious diseases and cancer, depression, suicidal ideation in adolescents, anxiety, and psychosis, exacerbation of schizophrenia, and fetal complications. Products/distribution of marijuana products need to be child-resistant, as there are documented cases of toddler deaths, and deaths among high school students. Colorado implemented safeguards to address risks to public health and safety, notably a sophisticated tracking system to trace each marijuana plant from the greenhouse to the point of sale, and monitoring of marijuana advertisement to protect younger audiences, sale of marijuana to individuals 21 or older. Use of marijuana is associated with increased risk of impaired driving. Increased business opportunities upon legalization such as marijuana courier services, marijuana tours although Colorado tourism officials were also concerned about the perception of their state. Approximately 9% of users become addicted to marijuana. Nurses can play a role in educating users and managing toxic effects, may benefit from continuing education related to marijuana.
Cannabis use and male reproductive health (29)	*Publication date:* 2015 *Jurisdiction studied:* Denmark *Methods used:* Retrospective analysis	Military draft from 2008-2012: 1215 men, 45.4% reported smoking marijuana in the past 3 months	Marijuana users vs. non-users	Men using marijuana more than once per week had significantly lower sperm concentration and total sperm count compared with nonusers. The combination of marijuana and other recreational drugs (e.g., amphetamine, ecstasy, cocaine) showed greater declines in sperm concentration, total sperm count, and sperm motility. No linear trend was identified on the basis of frequency of marijuana usage and semen parameters, suggesting a threshold effect.
Impacts of cannabis legalization on adolescent use, consequences and perceived risk (31)	*Publication date:* 2016 *Jurisdiction studied: USA (Greater Seattle Area),* *Methods used: Cross-sectional study*	Participants were 262 students enrolled in a school-based substance use intervention in 2010 to 2015.	The Customary Drinking and Drug Use Record, Alcohol and Drug Use Consequences Questionnaire, and a decisional balance matrix were used to assess marijuana frequency, negative consequences, and perceived risk of use. A mediation model was used to test the degree to which marijuana legalization may lead to increased frequency and consequences of use through perceived risk.	Significantly positive correlation between marijuana-related consequences and perceived risk post legalization. Despite relatively equal use between both groups, adolescents in the legalization group experienced higher levels of perceived risk and increased negative consequences. Psychoeducation provided to teachers, counsellors, parents, and adolescents should include the impact of underage marijuana use on physical, psychological, and interpersonal consequences. Similar to laws restricting minor use of alcohol, recreational marijuana use is limited to adults over the age of 21.
Adverse effects of medical marijuana (15)	*Publication date:* 2014 *Jurisdiction studied: N/A*	n/a	n/a	The components of cannabis, including cannabigerol (CBG), cannabinol (CBN), and cannabidiol (CBD), are not psychoactive as compared to THC. CBD has been shown to have anxiolytic, antipsychotic, anti-emetic, and anti-

Focus of study	Study characteristics	Sample description	Key features of the intervention(s)	Key findings
	Methods used: Narrative review			inflammatory effects. Cannabinoid intoxication can lead to decreased processing speed, attention span, recall abilities, reaction time, and psychomotor abilities when used in higher doses; can cause withdrawal symptoms; can result in drug dependency; can increase risk of psychosis and schizotypal personality traits in the long term. Smoking marijuana can lead to respiratory symptoms such as cough, increased sputum production, wheezing, and can be associated with pharyngitis, hoarseness, breathlessness, and exacerbation of bronchial asthma.
Adverse effects of cannabis use (17)	*Publication date:* 2016 *Jurisdiction studied:* USA *Methods used:* Narrative review	n/a	n/a	Recreational marijuana use negatively impacts psychomotor functioning including coordination, motor performance, and reaction time, which are all crucial tasks when driving a vehicle. Marijuana use was correlated with lower academic achievement, job performance, driving ability, and social functioning in relationships. Studies have found deficits in multiple domains of cognition including attention and working memory, processing speed, and executive functioning in recent marijuana users. Regular marijuana use can induce respiratory problems in the long term. Smoking marijuana has been found to increase risk of airflow obstruction, bronchitis, and airway injury such as edema. Regular marijuana use can lead to dysregulated growth of bronchial epithelial cells, and marijuana smoke contains carcinogens and co-carcinogens, all of which may play a role in the development of respiratory cancers.
Cardiovascular effects of cannabis consumption (25)	*Publication date:* 2016 *Jurisdiction studied:* USA *Methods used:* Narrative review	n/a	n/a	Compared with placebo, marijuana cigarettes cause increases in heart rate, supine systolic and diastolic blood pressures, and forearm blood flow via increased sympathetic nervous system activity. Marijuana has been associated with triggering myocardial infarctions (MIs) in young male patients, and increase the annual risk of MI in the daily cannabis user from 1.5% to 3% per year. Longitudinal studies have indicated that marijuana use may not have a significant effect on long-term mortality.
Medical marijuana in the workplace (11)	*Publication date:* 2015 *Jurisdiction studied:* USA *Methods used:* Narrative review	n/a	n/a	Smoking marijuana may involve respiratory health risks, and marijuana is not recommended for consumption by pregnant women because it is associated with fetal growth reduction and other negative outcomes. Cannabis has been found to have a negative effect on learning, memory, and is associated with deficits in attention, concentration and abstract reasoning, although these risks have not been found following acute-use of marijuana. Acute use of marijuana is associated with higher risk of a motor vehicle crash. In Colorado, employers did not need to accommodate the use of medical marijuana in the workplace, despite its legalization. There is a lack of standardized testing for THC impairment. A whole blood THC level of 5 ng/mL is generally accepted as the legal limit for motor vehicle operation in states where marijuana is legal, but should be combined with neurocognitive testing as a determinant of impairment.
Adolescent cannabis use in addiction	*Publication date:* 2014	n/a	n/a	While many studies have found associations with early cannabis exposure and illicit drug use, no causal relationship has been found. Cannabis use

Focus of study	Study characteristics	Sample description	Key features of the intervention(s)	Key findings
vulnerability (32)	*Jurisdiction studied:* USA *Methods used:* Narrative review			disorder is strongly heritable. Addiction vulnerability is difficult to generalize among all adolescents as behavioural and genetic factors moderate vulnerability. Adolescents undergo dynamic brain development and prolonged cannabis use can tamper with endocannabinoid system.
Cannabis use and cardiovascular disorder (26)	*Publication date:* 2014 *Jurisdiction studied:* France *Methods used:* Narrative review	n/a	n/a	Increased reporting of cardiovascular complications related to cannabis and their extreme seriousness (with a death rate of 25.6%) indicate cannabis as a possible risk factor for cardiovascular disease in young adults.
Cannabis legalization and adolescent substance abuse (14)	*Publication date:* 2014 *Jurisdiction studied:* USA (Colarado), Holland, *Methods used:* Narrative review	n/a	n/a	Adolescent marijuana use has been associated with impairment in a number of areas: impaired cognitive functioning, increased risk of developing marijuana dependence, elevated rates of school dropout, an elevated risk of developing psychotic illnesses, and an increased rate of engaging in risky behaviours.
Legalization of recreation cannabis and the health implications (18)	*Publication date:* 2016 *Jurisdiction studied:* USA *Methods used:* Narrative review	n/a	n/a	Short-term use can result in impaired memory, motor coordination, and decision making. Long-term use can affect brain development, functional outcomes, and mental health. Based on US trends following legalization of tobacco and alcohol, recreational cannabis will see a rise in use, and in frequency of use, while cannabis prices plummet. Use taxation to keep legal cannabis prices near to black market prices in an effort to limit probable increases in cannabis use and harm. Revenue from taxation can then be put towards public health programmes aimed at decreasing potential negative public health effects of legalised recreational cannabis.
Adverse health effects and regulatory regimes for alcohol and cannabis alcohol and (12)	*Publication date:* 2016 *Jurisdiction studied:* USA *Methods used:* Narrative review	n/a	n/a	The most likely short-term effect of cannabis legalisation will be a reduction in cannabis price, an effect which, in turn, will probably increase the frequency of use among current users. The most likely outcome of lower cannabis prices and higher potency will be an increase in cannabis dependence among current users. Increased use of cannabis products with high levels of THC may increase the prevalence of acute psychotic syndromes in cannabis users and worsen the prognoses of young people with psychoses who use cannabis. Industry-sponsored campaigns to "consume responsibly" may emerge following legalization.
Economic, social and health impacts of legalizing cannabis in Canada (13)	*Publication date:* 2016 *Jurisdiction studied:* Canada *Methods used:* Narrative review	n/a	n/a	With recreational and medicinal sales reaching almost $1 billion in 2015, Colorado collected more than $135 million in taxation revenue and fees by legalizing and taxing marijuana. Legalizing marijuana could create a $10 billion a year industry and the Canadian government can collect 50% or more of the potential $10 billion if there is a high "sin tax". Legalization can reduce black market activity. Marijuana use is associated with significant negative health effects.

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