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Cannabis and driving

Questions and answers for policymaking

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Contents

With cannabis use and policy evolving internationally, drug-impaired driving has become an increasingly relevant policy issue. This briefing aims to provide those concerned with policy developments in the field of cannabis with a brief overview of current knowledge and the latest developments in the area of driving.

The following topics are covered:

Third international symposium on drug-impaired driving

This joint policy briefing draws on the evidence presented at the Third international symposium on drug-impaired driving, which took place on 23 October 2017 in Lisbon. The symposium was a collaborative effort between the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), the Canadian Centre on Substance Use and Addiction (CCSA), the US National Institute on Drug Abuse (NIDA) International Program and the New Zealand Drug Foundation. More than 100 participants attended the high-level event, which brought together researchers, practitioners and policy experts from over 30 countries. All presentations and further information can be found on the conference website:
http://www.emcdda.europa.eu/meetings/2017/3rd-symposium-drug-impaired-driving_en

Terminology

Cannabis-impaired driving occurs when a person drives a motor vehicle when their ability to do so is impaired by the cognitive or psychomotor effects of tetrahydrocannabinol (THC) in cannabis.
A cannabis-positive driver is someone who drives a motor vehicle with detectable levels of THC in their blood, oral fluid or urine (depending on jurisdiction). Their driving may not necessarily be impaired by cannabis, for example if the THC level reflects cannabis use that occurred in the past but is still detectable.
Driving under the influence of cannabis, depending on the jurisdiction, may refer to a driver who has: a measured reduction in cognitive or psychomotor skills; more than a defined level of THC in the blood, oral fluid or urine, or any trace of THC in the blood, oral fluid or urine.

Part 1
Challenges for regulatory models

Why is cannabis use a road safety issue?

Consumption of cannabis affects cognitive and psychomotor performance in ways that can impair driving (Verstraete and Legrand, 2014; Hall et al., 2016). Cannabis contains a variety of cannabinoids, the most important being tetrahydrocannabinol (THC) and cannabidiol (CBD), which have very different effects on the brain. The relative amounts of these and other cannabinoids in cannabis plants and cannabis products vary widely. The THC in cannabis provides the predominant psychoactive effects and is considered to be mainly responsible for the impairment of function that affects driving ability.

Cannabis is a widely used substance. Within the general population, young adults have the highest rates of cannabis use (Canadian Centre on Substance Use and Addiction, 2017; EMCDDA, 2017) and are the age group at highest risk of motor vehicle crashes in the European Union (EMCDDA, 2012), Canada (Beirness and Porath, 2017), the United States (Substance Abuse and Mental Health Services Administration, 2017) and Oceania (Australian Institute of Health and Welfare, 2017).

The recreational use of cannabis has been legalised in nine states in the United States and in Uruguay (as of April 2018) and the Canadian government plans to legalise it in 2018. These developments have heightened concerns about cannabis and driving, for two broad reasons. First, they mean that, in these jurisdictions, cannabis use will no longer be illegal in itself, so laws on driving after consuming cannabis might become much more like those for alcohol. Second, if cannabis legalisation increases the number of individuals in the population who use the drug, then the number of people who drive after using cannabis may also increase. The extent to which such an increase actually occurs is not clear (see question 'Has cannabis legislation increased the number of cannabis-impaired drivers?' on page 11). Evaluation of the impact of legalisation on both the extent of driving under the influence of cannabis and the impact on road traffic accidents and associated injuries is therefore important.

What is the extent of cannabis-impaired/positive driving in different countries?

Information on the extent of cannabis-impaired or cannabis-positive driving is collected in a variety of ways, which makes comparison difficult. It can be estimated using:

- roadside surveys that (a) ask drivers about their cannabis and other drug use and (b) request biological samples to test for recent cannabis use;
- general population surveys that ask individuals who use cannabis how often they drive after using cannabis.

The first of these methods is considered more robust than the second, which relies on self-reporting of a socially undesirable behaviour and is therefore likely to be subject to under-reporting.

It is difficult to compare the scale of driving under the influence of cannabis in different countries because the studies performed to date have used different methods (EMCDDA, 2014). For example, variations in the times of day studied, groups of drivers tested or cut-off levels for 'positive tests' can lead to different results. A standardised survey in 13 countries in the European Union in 2007–2009 found THC in 1.3 % of a sample of the general driving population, although in individual countries the results ranged from 0 to 6 % (EMCDDA, 2014). The US National Highway Traffic Safety Administration (NHTSA) National Roadside Survey of Alcohol and Drug Use by Drivers in 2013–2014, using different methods, found that 12.6 % of weekend night-time drivers tested positive for THC.

Few surveys have been repeated to assess if these numbers are changing. In the US, the NHTSA roadside surveys have been conducted since 1973, but only the surveys in 2007 and 2013-2014 tested oral fluid and blood for the presence of drugs in samples of drivers. The prevalence of THC increased from 5.6 % in 2007 to 12.6 % in 2013-2014 (Berning et al., 2015). A recent study in Portugal found that the concentrations of THC found in blood samples taken from drivers increased between 2011

and 2013 but then remained fairly stable to 2015, with between 3 % and 4 % of drivers tested having THC concentrations of 10 ng/ml or more and about 30 % having concentrations of 3 ng/ml or above (Diaz, 2017) (see question 'What levels of THC in blood indicate impairment?' on page 9 for more information).

What are the risks associated with cannabis-impaired driving?

Cannabis use impairs skills related to driving in laboratory settings, as well as performance in driving simulators and in on-road driving studies (Compton, 2017b) but there is uncertainty about how these changes translate into crash risk (Compton, 2017a).

Assessing the risks of cannabis-impaired driving is further complicated by the fact that a number of factors can have an impact on whether a particular level of cannabis consumption will be associated with impairment of driving skills. These include the method of consumption (inhalation or ingestion; see question 'Do edible and smoked cannabis products affect drivers in the same way?' on page 7), whether the user is an infrequent or habitual user, and whether or not cannabis is used together with other substances, such as alcohol (Wolff & Johnston, 2014).

The impact of cannabis use on driving has been examined by a variety of different types of research. These have included:

- laboratory studies of the effects of cannabis on skills relevant to driving;
- studies of the effects of cannabis on driving performance in driving simulators;
- studies of the effects of cannabis use on real on-road driving, usually on closed courses;
- epidemiological studies of markers of cannabis use (usually the presence of THC) among injured and fatally injured drivers involved in road traffic accidents;
- meta-analyses of the individual epidemiological studies.

Epidemiological studies of people seriously injured or fatally injured in road traffic accidents measure concentrations of THC (or its metabolites) in blood and urine (EMCDDA, 2014). These use one of two main approaches. Case-control studies compare the levels of THC or its metabolites in drivers fatally or seriously injured with levels in controls (usually drivers of a similar age who have not been involved in accidents). Culpability studies examine the association between the presence of THC and other drugs and an expert assessment of whether the driver was responsible for the crash (a judgement that is made without knowing whether the driver had used alcohol or drugs).

Cannabis is the illicit drug most often detected in drivers who have been injured or fatally injured in North America, Europe and Oceania (EMCDDA, 2012). This is not surprising, since cannabis is the most commonly used illicit drug.

However, a major challenge in interpreting the case-control and culpability studies is that the presence of THC in blood or urine (measured some hours after a crash) does not necessarily mean that the driver was impaired by cannabis at the time of the crash (Beirness, 2017; Compton, 2017a) (see questions 'How useful are biological tests of THC in oral fluid and blood?' and 'What levels of THC in blood indicate impairment?' on pages 8 and 9). It only indicates that cannabis was used in the recent past by someone who uses cannabis occasionally, or longer ago if the person uses cannabis regularly.

Meta-analyses of these epidemiological studies (Asbridge et al., 2012; Liet et al., 2012; Rogeberg and Elvik, 2016) have indicated that cannabis use is associated with a modest increase in the risk of a crash. It is estimated that drivers who have recently used cannabis are on average 1.5 to 2 times more likely to be involved in a car crash (EMCDDA, 2012). Some researchers (Gjerde and Morland, 2016) argue that this may be an underestimate because of the often quite long delay between the crash and the taking of the blood sample (see question 'How useful are biological tests of THC in oral fluid and blood?' on page 8). The increased risk of an accident is less for cannabis-impaired than for alcohol-impaired drivers (Beirness, 2017; Compton, 2017a). A blood alcohol concentration (BAC) of between 0.08 % and 0.12 %, for example, increases the risk of an accident by 5 to 30 times (EMCDDA, 2012).

However, the results of the research on the risks associated with cannabis and driving need to be interpreted with caution for the following reasons:

1. The modest effects of cannabis use on behaviour and coordination in the laboratory might not be relevant to driving on the road.

2. Tests of injured and killed drivers may underestimate the risk, since they detect blood THC concentrations at the time of the test and not at the time of the crash, which may have been 1 to 2 hours earlier.

3. The presence of low THC concentrations in blood does not automatically imply recent cannabis use but may also be a result of past use in someone who uses cannabis regularly and may be unimpaired.

4. It is usually not possible to be certain if the presence of THC indicates that it was the main reason for the crash.

Do edible and smoked cannabis products affect drivers in the same way?

'Edible cannabis products' come in the form of cookies, confectionery and drinks that can contain substantial amounts of THC. In general, the effects of oral cannabis consumption are less predictable, the onset is slower and the effects last longer. In the US, there is a growing use of edible cannabis products for medical or recreational use, in part to avoid the health risks associated with the inhalation of cannabis smoke (McInnis and Plecas, 2016).

Laboratory studies have found important differences between the pharmacology of oral and smoked cannabis (Huestis, 2005). Smoking cannabis leads to a rapid rise in blood THC concentration and the associated onset of acute effects. Blood THC concentrations generally fall rapidly after smoking ceases, by 80 % within half an hour, although the effects can persist for four to six hours after use (Wolff et al., 2013). However, in daily or near daily users, THC accumulates in fatty tissue and then seeps back into the bloodstream, resulting in some THC being present in the blood over long periods.

In contrast, when cannabis is consumed orally, absorption of THC into the blood is much slower and less predictable. Behavioural effects set in with a delay of 30–90 minutes, reach their maximum after two to three hours and last for about 4–12 hours, depending on the dose (Wolff et al., 2013). When it is taken orally, less THC gets into the bloodstream, so the maximum concentration of THC in blood is lower than when cannabis is smoked. These lower concentrations, however, can persist much longer after oral use than after smoking cannabis (Vandrey et al., 2014).

A recent study among occasional and frequent cannabis smokers using common impairment tests (one-leg stand, walk and turn, etc.) found performance was significantly impaired after cannabis was consumed orally (Newmeyer et al., 2017). Again, it suggested that impairment is more prolonged and occurs later after cannabis is eaten than after it is inhaled.

The effects on driving ability of the variety of new cannabis products, such as those with high THC content (65-75 %) now appearing on the legal market in the US, are not known (Raber et al., 2015). As the range of cannabis products grows, it will be important to study how they are used, how they are metabolised and how they affect driving.

What are the regulatory options for addressing cannabis-impaired driving?

The policies to reduce cannabis-impaired driving have often been modelled on those that have proven effective in reducing alcohol-impaired driving over the past 40 years (Compton, 2017a). Therefore, they have included:

- roadside testing of probable cannabis-related impairment, using either (a) a test of behavioural impairment or (b) an oral fluid test administered by a police officer;

- for drivers who fail the roadside test (because the oral fluid test is positive or the police officer assesses the driver to be impaired), confirmation of the commission of an offence by a test to measure blood THC concentration;

- defining drug-impaired driving by law, based on a specified level of THC in the blood or, occasionally, in oral fluid (see question 'What levels of THC in blood indicate impairment?' on page 9).

Some jurisdictions have taken a zero-tolerance approach because of the illicit nature of the drug and set a low cut-off level in blood. This approach does not rely on the need to measure behavioural impairment.

People convicted of drug-driving offences usually lose their licence for some period or pay a fine or both. In some jurisdictions a prison sentence might be imposed for a higher range blood THC level, or on people with prior drug driving offences or those who have caused injury or death by such driving.

For the reasons examined in the next two questions, there are challenges in using the alcohol control approach to reduce cannabis-impaired driving.

Part 2
Drug screening, testing and detection

How useful are behavioural assessments of cannabis-related impairment?

In some jurisdictions, police officers can assess signs of behavioural impairment if they suspect someone is driving under the influence of drugs (Beirness, 2017; Beirness and Porath, 2017). This assessment can be done by sobriety assessments at the roadside. Drivers who fail the roadside behavioural test can be given confirmatory tests, either at the roadside or in a police station or medical setting (Beirness and Porath, 2017).

The most common roadside test of behavioural impairment in the US is the Standardized Field Sobriety Test (SFST). The SFST was designed to detect alcohol-related impairment based on known symptoms of alcohol consumption and impairment. As symptoms of cannabis impairment are different, it is not as sensitive to cannabis-related driving impairment; one study found the SFST identified only 41 % of cases of cannabis impairment correctly (Beirness and Porath, 2017; Compton, 2017a).

More detailed tests of behavioural impairment can be performed by specially trained police officers (usually in a police station). The Drug Evaluation and Classification (DEC) programme consists of coordination and divided attention tests; eye examinations; measurements of blood pressure and temperature; observations; and an interview. The DEC programme aims to determine if the suspect is impaired, whether this is due to drugs and which category (or categories) of drugs are most likely to be responsible. The DEC evaluation can take up to an hour. The DEC programme performs much better than roadside sobriety testing in detecting cannabis-related impairment, and trained officers are able to identify the class of drugs responsible for the impairment with an accuracy of 95 % (Beirness and Porath, 2017).

It may be difficult to implement the DEC on a large scale because it takes considerable time and money to train specialised officers to perform it and it is time-consuming for police officers to wait for a trained officer to perform a DEC. This is one reason that oral fluid screening for drugs is preferred in a number of countries.

How useful are biological tests of THC in oral fluid and blood?

A roadside oral fluid test can identify drivers who have recently used cannabis and who may *potentially* be cannabis impaired. Drivers who screen positive in the oral fluid test are usually required to provide a blood sample for testing of THC concentration. If their blood THC concentration exceeds a statutory level, they are defined as cannabis-impaired or driving under the influence. The threshold selected will have a significant impact on the numbers of people who will be prosecuted. A study of drivers found to be THC positive in Portugal showed that, if the concentration was set at 1 ng/ml, 67 % of drivers would have been prosecuted but, using a concentration of 3 ng/ml, only 26 % would have been prosecuted (Diaz, 2017).

There are challenges with using biological tests for THC to assess driving impairment. First, the outcomes of oral fluid screening and those from blood tests quite often do not match. In the United Kingdom, in cases where oral fluid screens were positive, 32 % of blood tests were found to be at or below the legal limit (Castillo, 2017).

Second, the amount of THC in blood or oral fluid is not as strongly related to driver impairment as BAC is to alcohol-impaired driving. The proportion of individuals showing impairment in several performance domains progressively increases as blood THC concentrations increase, but the rate of increase is quite low and the first indications of impairment have been demonstrated at THC concentrations between 2 and 5 ng/ml (Ramaekers et al., 2006).

Meta-analyses combining the data from a large number of studies have found that, in general, the higher the estimated concentration of THC in blood, the greater the driving impairment, but that frequent users of herbal cannabis show less impairment than infrequent users (unless used in conjunction with alcohol) at the same dose. Studies to date indicate that a blood concentration of about 3.7 ng/ml THC impairs drivers to a level equivalent to a BAC of 0.05% (0.5 mg/ml) (Berghaus et al., 2010).

In addition, there is a very sharp initial rise in blood THC concentration when a cannabis cigarette is smoked, followed by a rapid fall (Compton, 2017a) (see question 'Do edible and smoked cannabis products affect drivers in the same way?' on page 7). The rapid decline in blood THC level occurs while the psychomotor and cognitive impairments are most marked, namely starting 90 minutes after use and lasting for 2 to 3 hours.

However, THC can also be detected in blood at very low concentrations long after any cannabis-related driving impairment has disappeared, particularly in the case of frequent cannabis users. Blood concentrations of THC are also affected by the delay between a roadside oral fluid test and a confirmatory blood test (often up to several hours) (Compton, 2017a; Ramaekers, 2017). For example, in studies in the US, the typical time before blood is taken for testing following arrest for driving under the influence of drugs or being involved in a crash is 1.5 to 3 hours. In general, the longer the time between a roadside oral fluid test and a blood test, the lower the blood THC concentration.

It is perhaps for these reasons that a few jurisdictions, such as Spain, France, Cyprus and the Australian state of Victoria, have chosen to use oral fluid as the confirmatory test matrix and the result of the test as evidence for a conviction, following an initial screening test.

What levels of THC in blood indicate impairment?

As discussed above, there is no straightforward relationship between THC levels in the blood and impairment, but legal penalties are more likely to deter people from driving after using cannabis if there is a credible form of testing for impairment. Roadside oral fluid testing combined with a blood test and a specified level of THC that is taken to indicate impairment, is practicable for the police to enforce. The THC concentration specified in law to define impairment or driving under the influence differs between countries.

In Australia and many European Union countries, the THC concentration used to define a cannabis-related driving offence has been set between 1 and 2 ng/ml of THC in blood (ng/ml) (see Table 1). In a few European countries penalties increase with increasing blood concentrations of THC (e.g. the Netherlands and Norway) (see Hughes, 2017; Ramaekers, 2017; Vindenes, 2017). In some US states in which recreational cannabis use is legal, a concentration of 5 ng/ml has been defined as evidence of impairment (Compton, 2017a).

TABLE 1

Legal cut-off concentrations for blood levels of THC in some European countries

THC (ng/ml)	Country
1	Belgium Denmark Ireland Luxembourg Netherlands (if other drugs are present)
1.3	Norway (*)
2	Czech Republic United Kingdom
3	Netherlands (if THC only is detected) Norway (*)
9	Norway (*)

(*) In Norway, the severity of the penalty is increased according to the level of THC detected.

Source: Hughes, 2017

Expert committees in different countries have recommended concentrations of 5 ng/ml (UK) based on road traffic risk (Wolff et al., 2013) or 7 ng/ml (Ramaekers et al., 2004). However, THC concentrations used to define offence thresholds tend to be lower than those recommended by expert committees. For example, a level of 2 ng/ml was adopted in the United Kingdom, using the lower limit of quantification, taking into account potential accidental exposure. This reflects a zero-tolerance approach to driving under the influence of cannabis rather than a link to impairment.

The 5 ng/ml concentration adopted in some US states has also been criticised. It has been characterised as not sufficiently evidence-based and its adoption could lead to substantial numbers of drivers identified as behaviourally impaired by police officers being 'exonerated' by the blood test (Compton, 2017b). In Colorado, the 5 ng/ml concentration adopted was the concentration at which jurors could infer impairment, rather than being a strict limit.

In Portugal, where no threshold limit is provided for in law, a study comparing THC concentration ranges detected in drivers and the rate of prosecution for cannabis-impaired driving showed similar rates for all concentration ranges (Diaz, 2017).

Part 3
Preventing cannabis-impaired driving

How can the public and drivers be educated to discourage cannabis-impaired driving?

Individuals who use cannabis need to be educated about the risks of driving and discouraged from driving under the influence of cannabis (Beirness, 2017; EMCDDA, 2012). However, such education alone is unlikely to be sufficient to reduce cannabis-impaired driving because similar approaches have not reduced alcohol-impaired driving (EMCDDA, 2012). The programmes that have successfully reduced alcohol-impaired driving have combined education about the risks of driving after drinking with rigorous enforcement of laws that prohibit alcohol-impaired driving (defined by specified BAC levels).

A major challenge in discouraging driving after using cannabis is countering misconceptions among young people about the effects that cannabis use has on driving (Beirness and Porath, 2017; Grondel, 2017). Young people who use cannabis in Canada, the US and elsewhere, often believe that they can drive better after using cannabis because they take greater care. They might also think that, because cannabis produces less impairment and risk taking than alcohol, it is safe to drive after using cannabis; that is, they may confuse *lower* risk, compared with alcohol use, with *no* risk. They may also believe that they are at low risk of being caught if they drive after using cannabis (Beirness and Porath, 2017; Castillo, 2017; McKiernan and Fleming, 2017). This supports the idea that, to be effective, programmes will need to combine well-designed preventative education programmes about the risks associated with cannabis use and driving with enforcement of laws relating to driving under the influence of cannabis.

What sanctions would be most effective for cannabis-impaired drivers?

A wide range of possible penalties proportionate to the threat to road safety may be seen as more credible and coherent as a road safety policy, than applying the same penalty for all offences. For example, more severe penalties might be applied to people who drive with higher concentrations of THC in their blood (as indicators of cannabis-impaired driving), repeatedly engage in cannabis-impaired driving and use multiple drugs (including alcohol), as is the case in France, the Netherlands and Norway (Hughes, 2017; Ramaekers, 2017; Vindenes, 2017). Similarly, consistency with legislation on alcohol-impaired driving can also be viewed as important. In Norway, the concentrations of THC specified for different penalty levels were identified on the basis of comparability with penalties for alcohol-impaired driving (Vindenes, 2017).

In research about alcohol-impaired driving, rehabilitation courses show promising results, so referral for drug counselling or treatment can also be considered; Colorado has a treatment track for cannabis-impaired drivers (Davis, 2017).

Does biological testing for cannabis encourage use of alternative substances?

Testing for THC (e.g. using oral fluid testing at the roadside) could possibly encourage individuals who use cannabis to use drugs with similar effects that will not be detected by these tests (Loeffler et al., 2016). These drugs could include potent synthetic cannabinoids (a diverse range of substances that act on the same receptor systems in the brain as THC and are often sold as 'herbal smoking mixtures' with brand names such as Spice and K2), which have appeared in drug markets in recent years (EMCDDA, 2015). More research is needed to assess the prevalence of synthetic cannabinoid use among drivers and the severity of the impairment they produce. The former could be achieved by testing for synthetic cannabinoids in biological samples that have been tested for cannabis and found not to contain THC. The latter would require specialist, sophisticated laboratory equipment and driving simulator and epidemiological studies. In response to concerns about increasing use of synthetic cannabinoids, tests for a range of synthetic cannabinoids are being

developed, although few are available for routine testing. A major research challenge, however, is the diversity within this group of substances.

How should the law treat people who use cannabis for medical reasons and drive?

In the US and Canada, several jurisdictions permit smoking cannabis for medical reasons. In the European Union, smoking is not permitted, but in the last few years several countries have permitted vaporising or infusion of cannabis for a limited number of conditions. Prescribing practices are not standardised and range from being loosely to tightly controlled. The increased availability of cannabis and THC for medical use could increase the number of people who are detected driving with THC blood concentrations in excess of 1-2 ng/ml. The issue has parallels with concerns about the potential effects on driving of other medicines, such as sedatives and opioids.

In some countries, people who drive after using cannabis for medical reasons or approved pharmaceutical medical cannabis products are exempted from prosecution for cannabis-impaired driving if they can show that they were prescribed the substance and were not impaired. This is the policy in Ireland (Maguire, 2017), Norway (Vindenes, 2017) and the United Kingdom (Wolff, 2017). The main argument for granting an exemption is that it will enable patients who use cannabinoids for medical purposes to live a more normal life. The fact that regular use of cannabis could result in low levels of THC in the blood for long periods following use without apparent impairment may be a consideration. The counterargument is that use of prescribed cannabis can still cause impaired driving and threaten road safety.

Has cannabis legalisation increased the number of cannabis-impaired drivers?

There is a concern that decriminalisation and legalisation of cannabis for recreational use might increase the prevalence of cannabis use and, by extension, its use among drivers. Legalisation may, for example, make cannabis easier to access, reduce its price and social disapproval of its use and enable individuals to use cannabis without fear of arrest (Hall and Lynskey, 2016). There is conflicting evidence from population surveys in the US on whether use has increased in states that have adopted more liberal medical cannabis laws or have legalised recreational cannabis use (Lynskey and Hall, 2016).

Since Washington state and Colorado legalised recreational cannabis use by adults (Davis, 2017; Grondel, 2017), there has been an increase in the number of drivers detected driving after using cannabis. However, there has also been an increase in rates of testing drivers for recent cannabis use because drug driving laws have been enforced more stringently. This increase makes it difficult to interpret these findings.

Part 4
Future perspectives for research and monitoring

How can knowledge of the number of cannabis-using drivers on the roads, and their role in accidents, be improved?

Data need to be collected in standardised ways to enable cross-national comparisons of the rates of cannabis-impaired driving or driving under the influence of cannabis. Ideally, this collection would include regular roadside surveys coupled with the testing of biological samples to monitor trends in cannabis use and driving (Wolff et al., 2013; Wolff, 2017; Compton, 2017a). It would also include monitoring the prevalence of cannabis and other drugs in those involved in road fatalities and injuries, using standardised analytical methods (EMCDDA, 2012) and data collection techniques.

Jurisdictions that have legalised cannabis use (or are considering doing so) could put in place systems for monitoring cannabis-impaired driving (before and) after legalisation. These systems might include regular roadside drug testing and the use of standardised approaches to analysing biological samples for evidence of recent cannabis use in drivers who have been killed or seriously injured in car crashes (Compton, 2017a).

Larger and better controlled studies are needed to determine precisely the contribution that cannabis use makes to road crash fatalities and serious injuries (Compton, 2017a). There are few studies of cannabis-impaired driving that are as large and as well designed as those that have been carried out on alcohol-impaired driving.

There is a need for more basic research on the pharmacology of cannabis to provide biological and behavioural measures of cannabis-impaired driving that can be used to identify and deter drug-impaired driving. For example, the use of blood spots (from finger pricks) is a potentially innovative approach that could allow the measurement of blood THC closer to the time of an accident or detection by police than is currently possible (Sadler et al., 2017), but as yet this testing has not been sufficiently developed to be put into routine use (Wolff et al., 2017). Its feasibility and validity need to be investigated (Quraishi et al., 2017) alongside other potential methods, such as roadside testing using latent fingerprints and detection in exhaled breath.

How can policies addressing cannabis-impaired driving be evaluated?

We need better evaluations of the effectiveness of policies to deter cannabis-impaired driving (Flieger, 2017; Hughes, 2017; Wells, 2017). These policies have been in place in Australia for 17 years but their impacts have been poorly evaluated (Davey et al., 2017). Similar policies have recently been introduced in the EU and US. Studies evaluating them have been limited to describing enforcement activities rather than evaluating their impacts on the prevalence of cannabis-impaired driving, injuries or fatalities (e.g., Castillo, 2017; Diaz, 2017; Vindenes, 2017; Wolff, 2017).

These evaluations have reported on the number of drivers tested for different types of drug use; the number who tested positive; and the number convicted of drug-impaired driving (e.g., Castillo, 2017; Davey et al., 2017; Diaz, 2017; Vindenes, 2017; Wolff, 2017). Increased drug testing could produce a public health impact on cannabis-impaired driving, but this might not be sufficient.

Future evaluations need to examine trends in road fatalities and injuries in which alcohol, cannabis and other drugs are detected post mortem; changes in public attitudes towards the acceptability of driving after using cannabis; and changes in young adults' perceptions of the risks of being detected by the police if they drive after using cannabis (Hughes, 2017).

There is also a need to evaluate the effects of education and prevention programmes. This evaluation should include research on how to convey information about the risks of driving after using cannabis and how best to discourage people from engaging in this behaviour.

Evaluations are needed of the cost-effectiveness of drug testing, much like economic evaluations of policies to reduce driving under the influence of alcohol. These need to consider the opportunity costs of enforcing laws against cannabis-impaired driving instead of those against alcohol-impaired driving. Alcohol-impaired driving remains a much larger road safety and public health problem than cannabis-impaired driving (despite success in reducing its prevalence) because alcohol is a more serious cause of driver impairment and many more drivers drink alcohol than use cannabis (EMCDDA, 2012).

Most of the research on the prevalence of cannabis-impaired driving and most evaluations of policies to reduce cannabis-impaired driving have been done in high- and middle-income countries, such as the Member States of the EU, the US and Australia. There has been very little evaluation of how useful these policies may be in discouraging cannabis-impaired driving in low- and middle-income countries in which this behaviour might also be common. Research is needed in these countries to develop practicable ways of enforcing laws against drug-impaired driving (Khayesi, 2017).

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About this publication

With cannabis use and policy evolving internationally, drug-impaired driving has become an increasingly relevant policy issue. This briefing aims to provide those concerned with policy developments in the field of cannabis with a brief overview of current knowledge and the latest developments in the area of driving.

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The European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) is the central source and confirmed authority on drug-related issues in Europe. For over 20 years, it has been collecting, analysing and disseminating scientifically sound information on drugs and drug addiction and their consequences, providing its audiences with an evidence-based picture of the drug phenomenon at European level. The EMCDDA's publications are a prime source of information for a wide range of audiences including: policymakers and their advisors; professionals and researchers working in the drugs field; and, more broadly, the media and general public. Based in Lisbon, the EMCDDA is one of the decentralised agencies of the European Union.

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