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EDITORIAL

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How research and policy can shape driving under the influence of cannabis

In the wake of widespread cannabis legalization in the United States (US) and internationally, law enforcement and policy makers are at a standstill on solutions to deter people from driving under the influence of cannabis (DUIC). As the prevalence of cannabis use increases, the public perception of DUIC as safe and devoid of consequence is growing. Shifting this perception and preventing DUIC will require clear messaging about risk, development of a consistent DUIC impairment standard and DUIC-specific statutes and law enforcement efforts.

There has been an increase in prevalence of driving under the influence of cannabis (DUIC) and in fatal motor vehicle collisions in US states [1] and other countries following recreational cannabis legalization (e.g. Uruguay [2]; Canada [3]). Studies have found that acute cannabis intoxication is associated with a statistically significant increase in motor vehicle collision risk [4]. Cannabis impairs psychomotor skills critical to driving in both occasional and heavy users [5]. This is particularly concerning because of the increasing potency of Δ9-tetrahydrocannabinol (THC) concentration linked with more severe withdrawal and motor impairment [6].

Despite the unequivocal evidence that cannabis acutely impairs driving-related skills and increases risk, public attitudes toward DUIC are highly permissive in the United States and in Australia, particularly among medical cannabis users [7]. DUIC is perceived as safe, normative and associated with fewer consequences than alcohol-impaired driving [8]. However, this may not extend to other countries with high prevalence of cannabis use [9–11]. As the prevalence of cannabis use and DUIC increases, challenging and correcting these perceptions is imperative for the new generations of drivers who also use cannabis. To this end, we need universal objective standards for DUIC, combined with consistent DUIC-specific offenses and sanctions, to ensure highway safety [5].

Many countries have achieved significant reductions in alcohol-impaired driving and fatalities through a combination of policy, law enforcement and public awareness campaigns [12]. Of these, perhaps the most successful has been *per se* blood alcohol concentration (BAC) legal limits, currently 0.08 in 49 US states and 0.05 in many industrialized nations [13]. *Per se* laws provide a clear, consistent standard for defining prohibited levels of alcohol-based impairment for driving and are thought to reduce alcohol-impaired driving by increasing the perceived risk of arrest [14], particularly when combined with visible enforcement.

Unfortunately, replicating this effective policy/enforcement combination for DUIC is complicated by differences in pharmacology and impairment indicators between the two drugs. Currently, there are no reliable and practical biochemical or behavioral on-the-road methods to establish cannabis-induced impairment. In contrast to alcohol, there is poor correspondence between levels of THC in biological specimens (e.g. blood, saliva) and psychomotor impairment [15]. THC-induced impairment continues well after the decline of THC in blood and oral fluid. Maximal impairment is typically observed during the first hour after inhalation, with subsequent declines over 3 to 4 h [15, 16] and recovery of most driving-related skills within 5 h [17]. However, there is a substantial delay in the time course for impairment following oral ingestion, with at least 8 h of driving-related cognitive impairment [17] and substantial individual variability in THC's pharmacokinetic profile. Such poor correspondence produces significant challenges for DUIC policy and prevention efforts.

These challenges underscore the complexities in developing clear, consistent and enforceable policies to limit DUIC. The most promising approach would be behavioral assessment of impairment combined with a positive biomarker test [18]. Ideally, this combination would use a "successive hurdles" approach, where an initial step with high sensitivity to detect recent cannabis use would be followed by a more thorough assessment with high specificity to detect impairment. Although there are promising methods for such an approach, there are several problems that would need to be resolved prior to implementation.

Oral fluid (OF) tests are likely the best candidates for detecting recent use. OF screening is non-invasive, carries minimal risk of adulteration, can be conducted in proximity to the time of driving and has reduced interindividual variability and reduced variability between THC doses compared to blood [19]. At very low thresholds (e.g. ≤1 ng/mL), OF testing detects recent (past 3 h) use of smoked THC with very high sensitivity, but has modest specificity and longer detection windows, which may lead to positive tests outside of the typical time course of impairment [19]. A higher cut-off of 10 ng/mL has better specificity for detecting recent use, although THC remains detectable in a small proportion of users long term [20]. Higher cut-offs also risk missing occasional users who may be impaired. Further complicating the issue is the difference in impairment time course

between THC administration routes (i.e. inhaled vs oral), and research on OF testing and edibles is lacking. Current OF screening devices cannot serve as evidence of *per se* impairment, but can serve as a first pass screener of recent use for follow-up behavioral assessment.

The Drug Evaluation and Classification Program (DECP), developed by the US Department of Transportation National Highway Traffic Safety Administration and the International Association of Chiefs of Police, certifies law enforcement officers as Drug Recognition Experts (DREs) to conduct psychophysical tests and recognize signs of drug-related impairment. In a comprehensive study of this program, the most reliable cannabis impairment indicators included elevated pulse, dilated pupils and other eye exam markers and impairment on the standardized field sobriety test [21]. Despite its demonstrated validity and reliability, obtaining and maintaining this certification is onerous, resulting in a limited number of certified experts.

Given the limited specificity of the biomarker cut-off in screening and limited availability of DREs, further research is needed to support DUIC-specific statutes and the determination of DUIC events. First, controlled research with oral administration and varying THC concentrations is needed to determine OF cut-off levels that correspond to the time course of behavioral impairment. Second, the development and validation of technological tools that can reliably detect impairment, supplement DRE evaluations and increase the availability of behavioral assessments is crucial. This is particularly critical for individuals who use cannabinoids for medical indications with a consistent dosing regimen, who may develop tolerance to THC effects. These individuals may be less impaired when driving [22] and can test positive on OF screening, therefore, could benefit from sensitive behavioral assessment. In fact, medical cannabis legalization may be associated with reduced motor vehicle collisions and related mortality [1]. Finally, research on combining OF testing and behavioral assessment, currently used in some countries (e.g. Australia), and their sensitivity and specificity is indicated. Such research is needed to develop a consistent impairment standard for DUIC-specific statutes and enforcement efforts. Doing so can provide a clear message about the risk of DUIC, help shift inaccuracies in public perception and aid individuals in making safer driving decisions.

KEYWORDS

cannabis, driving, impairment, oral fluid, policy, THC

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Jane Metrik: Conceptualization (equal); data curation (equal); funding acquisition (lead); methodology (equal); resources (equal); writing—original draft (equal); writing—review and editing (equal). **Denis M. McCarthy:** Conceptualization (equal); data curation (equal); methodology (equal); resources (equal); writing—original draft (equal); writing—review and editing (equal).

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DECLARATION OF INTERESTS

None.

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