

Recommended Approaches to Evaluate Methodologies and Technologies for the Detection of Cannabis- Impaired Driving

RFI Response

October 3, 2023

Prepared For:
New York State Department of Health

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Better Data. Better Policy. Better Outcomes.

October 3rd, 2023

To Commissioner Dr. James V. McDonald, New York State Department of Health,

We are pleased to respond to your request for information (RfI) regarding cannabis impairment detection and roadway safety.

Cannabis Public Policy Consulting, LLC, has prepared the following report for your review. Our in-house scientific and public-policy data experts have summarized current and emerging technologies for the chemical identification of cannabis and the detection of behavioral impairment and have referred to external sources where appropriate. We are not an academic institution of higher education and are not a vendor in that we do not have a product to be tested, nor intellectual property to be protected. Therefore, we have not responded to Section D in the RFI directly. However, we are poised to pursue partnerships with academic laboratories or for-profit agencies to find solutions to cannabis impaired driving; please see section **IV. Recommendations for further research** in this report.

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Dr. Kirshenbaum is a psychopharmacological researcher who has specialized in many areas of substance abuse, including cannabis-impairment detection. He is former Professor of Psychology and Neuroscience has received funding from the *National Science Foundation* for his work in cannabis, and from the *National Institutes of Health* for research in other areas of drug abuse. Dr. Kirshenbaum is an Instructor in the *Drug Recognition Expert* training program in New England for law-enforcement personnel and has given many talks and seminars on the dangers of cannabis and motor-vehicle operation.

Thank you,



Mackenzie Slade, MPH
Executive Director

Background

In September 2023, New York State Department of Health (DOH) issued a [Request for Information](#) (RFI) regarding methodologies and technologies used for the detection and assessment of driving under-the-influence of cannabis (DUIC). The RFI purpose is to assist the DOH in assessing the current state of research on impairment due to cannabis ingestion, and to review current devices that can be used to detect impairment. Moreover, the DOH is seeking to identify research institutions in higher education that are currently performing this type of research.

About Cannabis Public Policy Consulting

We are the leading original cannabis research-to-practice consulting firm in the United States. We offer a multidisciplinary approach to data-informed policymaking. Our mission is to embed advanced data and our implementation science expertise in cannabis policymaking to protect public health and safety, promote equity, and streamline regulatory systems affecting the cannabis industry.

The information which was requested by the NY DOH is delineated into four sections, described below. In summary, there exists no standard practice nor consensus regarding the detection of cannabis-related driving impairment. In states in which there is some form of state-sanctioned cannabis regulation, current practices of identifying cannabis-caused impairment rest on the detection of both behavioral irregularities and chemical/biomarkers of recent cannabis use.

I. Intoxication by Cannabis Increases the Risk of Vehicle Crash

Secondary only to alcohol, tetrahydrocannabinol (THC) is the drug compound most likely to appear in toxicological screening after fatal motor vehicle accidents,¹ yet driving during cannabis intoxication is an underappreciated public-safety risk factor.² The evidence that THC intoxication causes neurocognitive and behavioral impairments³ that interfere with motor-vehicle operation⁴ is indisputable. The pertinent question for public safety personnel is the degree to which cannabis causes these impairments, and how law enforcement efforts can abate the impact of cannabis consumption on highway safety.

A 2021 “umbrella review” of several statistical meta-analyses⁵ on cannabis impairment placed the crash-risk odds ratio between 2.1 and 6.6. This means that, at the very least, cannabis ingestion doubles the chances of incurring an automobile crash during operation. The range (2.1-6.6) described in the report³ was dependent upon the nature of the comparison group which is a statistical requirement for establishing an odds ratio (e.g., culpability control vs. cohort comparison) and whether the crash resulted in injury or fatality. Although not explicitly identified in the umbrella review, we believe that it included over a quarter-million incidences in which cannabis resulted in a crash.

II. Current Methods of Detecting Impairment and THC

Methods for detecting the chemical presence of cannabis do not also test for neurocognitive and psychomotor impairment. Furthermore, there is no established linear relationship between blood concentrations of THC and deficits in driving skill as there exists with alcohol (i.e., BAC limits). For this reason, methods for the detection of cannabis (e.g., blood tests) should be combined with

behavioral assessments (Drug Recognition Expert evaluations) to demonstrate that behavioral impairments are a product of cannabis consumption and not due to peripheral variables.

Impairment Detection: Roadside and Station Identification

Driving behaviors that demonstrate “impairments to the slightest degree” serve as reasonable suspicion and justification for a traffic stop. Motor-vehicle operators suspected of having used cannabis in New York may be subjected to a chemical test of breath, blood, urine, or saliva under the direction of an officer who has determined probable cause; see “implicit consent to be tested,” under *McKinney’s Vehicle and Traffic Law* § 1194.2. Confirmation of the chemical test can be confirmed elsewhere with a secondary biomarker test performed by someone other than the arresting officer, which is typically a test of blood or urine. The motor-vehicle operator is also permitted to receive a chemical test by a physician of their choosing, in addition to the test at the direction of an officer.

The *Governors Highway Safety Administration* shows that ten states currently have zero-tolerance policies for THC (or its metabolites), and 5 states have blood (5ng/ml THC) and urine (50ng/ml carboxy THC) *per se* detection limits. As the primary threshold to determine impairment, these detection limits go against the recommendation of a 2017 Report to Congress by the *National Highways Traffic Safety Administration* (NHTSA).⁶ The report states that:

“A number of States have set a THC limit in their laws indicating that if a suspect’s THC concentration is above that level (typically 5 ng/ml of blood), then the suspect is to be considered impaired. This *per se* limit appears to have been based upon something other than scientific evidence.”

Canada has approved the use of Dräger Drug Test ® 5000 for point-of-collection test results at roadside, and some states with a *per se* thresholds or zero-tolerance policies have also adopted it. Some states (e.g., Vermont) prohibit the use of oral-fluid testing due to poor specificity, sensitivity, and reliability of these measures. These terms, “specificity, sensitivity, reliability,” are technical in that they refer to the statistical validity of whether the test identifies (a) cannabis and *only* cannabis, (b) low doses and other alternatives to *delta*⁹THC, and (c) whether they reliably recognize cannabis when it is present, and do not identify it when it is not present. For instance, studies have found that there is a 19% failure rate of Dräger Drug Test to accurately detect cannabis, and this failure rate includes false-positive identification.^{7,8} Also complicating the use of *per se* thresholds, is that biomarker tests can overshadow negative behavioral results from Standard Field Sobriety Testing (SFST) and DRE evaluations; the absence of the verification of behavioral impairment can further irregularities and disparities in arrest and conviction.

At the time of the traffic stop, the officer may administer the Standard Field Sobriety Test (SFST). In New York, it is our understanding that all state troopers are required to have completed the Advanced Roadside Impaired Driving Enforcement (ARIDE) training curriculum. This training curriculum was developed in conjunction with the NHTSA. The results of the SFST are documented by the officer, and further evaluation of the suspect can be performed by a Drug Recognition Expert (DRE) after the suspect has been escorted to the station. There can often be a significant delay between when the suspect is identified at roadside and the DRE can perform the evaluation. Despite the elimination half-life of cannabis being several days, the identifiable effects of cannabis on

behaviors persists for a handful of hours, and key evidence of impairment may be lost during the delay in between the SFST and DRE evaluation.

The DRE training course is a two-week additional curriculum available to officers and state prosecutors and provides information on basic neurophysiology which is the framework for which drug impairment is predicated. However, the DRE program has no standardized training session on cannabis-related impairment when dedicated sessions exist for other psychoactive classes of drugs. During certification, DREs are trained to identify both the acute effects of drugs on the nervous system, but also the aftermath effects. While these aftermath effects are well understood and recognizable for many drugs (e.g., sleepiness after stimulant usage), they are less well-elucidated for cannabis. Again, there is a possibility that important symptoms of cannabis intoxication and impairment will be lost if DREs cannot perform their assessments in a critical window, which is typically within 3-5 hours post ingestion.

Chemical Verification: Laboratory Identification of THC

Toxicological testing in state laboratories evaluates both the presence of tetrahydrocannabinol (THC) and its primary metabolites that can be detected in saliva, blood, or urine. As opposed to urine, which relies on the presence of metabolites, blood and oral-fluid tests are considered “recent-use detection methods,” because they can detect THC before it has gone through any physiological metabolic processes. The gold standard for laboratory testing is the combination analytical chemistry technique called liquid-chromatography mass spectrometry (LCMS). Roadside detection kits, such as the one developed by Dräger, are often tested for accuracy against LCMS analysis.

In the sequence of processing, a forensic sample at state laboratories often goes through a variety of steps which utilize simpler binding assays before reaching LCMS, and LCMS is used as the final verification of the presence and concentration of THC and metabolites. While these simpler assays can be very sensitive to *delta*⁹THC, they can often miss identification of other cannabinoids, such as *delta*⁸THC, tetrahydrocannabinophorol, and synthetics (e.g., “Spice”). The determination of behavioral impairments during DRE evaluation can help to promote a forensic sample down the sequence of analytical chemical tests toward LCMS in the absence of positive detection by other analytical chemical testing assays; this is among one of the most valuable aspects of DRE identification.

Limitations of Current Methods

Recently, direct empirical testing of *per se* limits in actual driving behaviors has demonstrated critical failures.⁷ In some instances, when biomarker testing of THC is *beneath* the threshold, driving performance can be significantly and dangerously impaired. Under other circumstances, those testing far-above the threshold performed satisfactorily in a driving simulator. Again, for these reasons, chemical biomarker testing for cannabis cannot be used to identify impairment and should not be used as the primary evidence in any DUIC prosecution.

While urine and saliva specimens can be used to detect the presence of cannabis, whole blood and plasma analysis may be the most accurate biomarkers of the recency of cannabis use. Oral fluids, in general, are less preferred because their accuracy can be influenced by many factors other than the direct ingestion of cannabis. Saliva concentrations are poorly correlated with blood-circulatory levels of THC, and the blood levels are what ultimately impacts the functioning of the brain.⁹ Cannabinoids

present in urine have a sufficiently long window of availability for detection, but the elimination of cannabis through the kidneys is non-linear and this prevents accurate estimation of *when* and *how much* cannabis was consumed; furthermore, as described above, urinalysis screenings can miss opportunities for detecting cannabinoid alternatives to *delta*⁹THC.¹⁰ Frequency of cannabis use can alter the levels of THC in blood and cause biomarker testing to overestimate the degree to which THC is active in the brain.¹¹ Thus, biomarker/chemical-detection measures tend to overestimate the influence of cannabis currently operating in the brain of frequent consumers and can misrepresent the degree of intoxication.

SFST have inconsistently identified the presence of cannabis,¹² and generally, legal-defense arguments against roadside SFST have been predicated on reliability failures of the practice.¹³ Furthermore, although DRE evaluations for cannabis-specific impairment have received some empirical support,¹⁴ recent evidence in a psychopharmacological testing lab directly calls the sensitivity and reliability of these evaluations for cannabis into question.¹⁵

The Importance of Timing

Of great concern is the finding that perceptions of ability to drive do not mirror driving-related impairments.¹⁶ There may be a critical danger zone, between 1.5-5 hours after consumption, during which impairments still exist yet intoxication has abated and the impairments themselves are not apparent to the consumer.^{16,17} As mentioned earlier, there can often be substantial delays before a DRE evaluation can be performed, and this may mean that important pieces of behavioral evidence of intoxication are unavailable to prosecutors. The delays may stem from the limited number of DRE-trained personnel available in New York.

Recent investigation published in a highly respected journal provides strong conclusions that SFST should not be used in the absence of biomarker testing of cannabis because of poor reliability, and that oral fluids help to resolve inconsistencies in officer observations.¹⁸ In this study, participants consumed placebo or cannabis, and saliva-testing results were used to help resolve conflicting (i.e., *false-positive*) results reported by the SFSTs. Although the addition of oral-fluid testing helped to avoid what would be problematic arrest based upon SFST alone, the study did not address the time-course of the psycho-action of cannabis. In our opinion, what would have provided more information, is for the SFSTs to be performed and oral fluids collected 3+ hours after cannabis use; in which case, impairments may or may not be present in SFST, but saliva may still indicate above-threshold levels of THC. Nonetheless, the study did help to provide a strong policy recommendation: detection of actual behavioral impairment by SFST (and DRE for secondary confirmation) should occur *prior* to the administration of a chemical test, such that the biomarker sample serves to identify the presence of cannabis and resolves any question about the source of the impairment.

The Question of Tolerance

Tolerance is typically defined as the increase of drug dose to compensate for the abating subjective effect of cannabis after repeated consumption. Questions remain about whether behavioral tolerance occurs in cannabis; perhaps a synonym for behavioral tolerance, is impairment tolerance. Impairment tolerance, if it exists, may be evidenced in very particular aspects of human performance. For instance, one lab has repeatedly found that frequent users of cannabis do not exhibit the same degree of cognitive impairment from lab-administered cannabis as infrequent users do.^{19,20} Other reports have demonstrated that even daily users still perform poorly on a variety of cognitive and behavioral tasks

relative to non-using controls.¹⁷ The inconsistent findings of impairment tolerance in frequent users is difficult to understand, but it may have to do with the types of cognitive tests used by different labs. The argument could be made that impairment tolerance is a product of experience, such that tolerance is a product of learning to perform a particular task while under the influence of cannabis. If this is the case, then tolerance would be very specific to tasks that have been encountered frequently after using cannabis. For instance, DUIC may be more problematic for infrequent users of cannabis, but frequent users may have learned to better tolerate the impairing effects of cannabis on motor-vehicle operation simply because they have engaged in that activity numerous times after use (and have therefore jeopardized others on the highway many times in the past while acquiring tolerance). Any behavioral test of impairment will necessarily need to be empirically evaluated with naïve, occasional, and frequent cannabis consumers to make determinations about the influence of a history of drug use on those tests.

III. Emerging Novel Technologies to Detect Cannabis Impairment

Digital Behavioral-Impairment Assessment

Rapid neuropsychological test batteries have emerged from many labs which provide opportunities to standardize behavioral/impairment testing by presenting tests on a mobile tablet or phone. At least two versions are available to be downloaded by individual cannabis users, these being DRUID^{15,21} and Indicator.¹⁷ DRUID is designed to be used by law enforcement or employers, and Indicator was created to help educate home users of cannabis about the ways in which it impairs specific areas of cognitive function. Like SFST and DRE evaluations, these test batteries contain multiple tasks, each which indicate behavioral deficits. The pattern of performance deficits, and not the performance on any single test, determines impairment. The advantage of these digital assessments is that they standardize behavioral testing at roadside. Since they would be administered inside a vehicle, they would also make roadside testing safer for the motor-vehicle operator so that they and the officer do not need to stand near moving traffic during an assessment. Furthermore, pre-existing physical limitations (e.g., neuropathy) of motor-vehicle operators may be better addressed with a mobile-tablet assessment relative to the walk-and-turn and Romberg-balance portions of the SFST. Academic laboratories, such as the University of San Diego, University of Chicago, Stanford, Rutgers, etc., are developing similar technologies. Although reliability and validity still need to be demonstrated with these devices, some practical considerations may limit their utility, such as when the test battery would be administered in the chain-of-custody.

Digital Physiological-Impairment Assessment

Current DRE evaluations contain the examination of ocular indicators of cannabis intoxication. These include horizontal-gaze nystagmus, pupillary size and light-sensitive rebound, and pupillary in convergence. Studies have been published to demonstrate these effects.²² Several companies are developing mobile-app or tablet versions of technology to detect these aspects of ocular response, but none have been empirically validated and peer reviewed (required for Frye or Daubert legal standards). Ocular-response detection technologies, such as IMMAD, ZXEREX, Oculogica, Gaize, are untested but may hold promise. Academic institutions such as the University of Colorado²³ appear to be developing technologies. One limitation of ocular indication of cannabis intoxication is that it may be difficult to tie these pupillary responses to actual impairments in driving. To the best of our knowledge, correlations of pupillary assessment to driving-related deficits (with a driving

simulator) have not yet been performed, which would be a necessary step in validation.

Advances in Chemical Assessment

Due to their ease of use and practical acceptance as a method of blood-alcohol concentration detection, enthusiasm from law enforcement for breathalyzers has been overwhelming, evidenced by the \$20 million in capital raised by the company at the forefront of product development (Hound Labs, CA). Although breathalyzers showed early promise,^{24,25} the enthusiasm was probably not warranted. A recent 2023 review concluded that “...results do not support the idea that detecting THC in breath as a single measurement could reliably indicate recent cannabis use.”²⁶ As with other chemical biomarker detection methods, even if successful, breathalyzers can only confirm a history of recent cannabis use and cannot detect actual impairment.

Developments in oral-fluids testing may lead to more accurate methods than those described earlier. For instance, biochemists at the University of Texas at Dallas have recently published a electrochemical sensing system²⁷ which relies on a novel technique for cannabis detection. Similar devices are being developed elsewhere (non-domestically)²⁸ so there is reason to be hopeful that this technology may be more suitable than saliva testing kits currently deployed in the US.

Direct Brain Response

Cerebral blood flow, functional response and connectivity, and cannabinoid and dopamine-receptor activity are all influenced by cannabis administration and evident in brain-imaging studies.²⁹ However, few of these brain responses would be amenable to roadside or station identification. Select brain imaging techniques and electrical monitoring may hold some potential to detect the action of acute effects of cannabis, but this is largely untested. A lab at Harvard has identified that oxygenated hemoglobin flow can be evaluated with functional near-infrared spectroscopy, since changes in frontal lobe flow correlate with intoxication and impairment.³⁰ A group affiliated with the University of Iowa (National Driving Simulator Lab)³¹ has witnessed changes in theta waves in electroencephalography (EEG) that correspond to cannabis intoxication and impairment. Both of these testing device are portable enough to be used on site, and not in an academic lab.

IV. Recommendations for Further Research

Despite substantial research performed on cannabis and driving-related impairments, there exists no current federal standardized approach to accurately detecting it at roadside. Unfortunately, SFSTs fall short of reliably capturing critical aspects of acute cannabis intoxication and impairment, and we believe that traffic-safety officers are sensitive to these failures and are underconfident in making a DUI arrest. More sensitive, specific, and reliable techniques are desperately needed.³² Involving psychopharmacological experts in developing more effective and sophisticated behavioral tests to be performed at roadside would be an important step that may not involve the development of new digital or chemical technology. Helping the DRE training program to develop core curriculum specific to cannabis would also be an important step forward. Increasing the effectiveness of the methods used in SFST and DRE could be a rapidly scalable solution since all states have versions of ARIDE or DRE training curriculum. The expertise unique to Cannabis Public Policy Consulting can be helpful in several ways in this regard:

- Our surveillance team can survey state troopers and police to assess the extent to which DREs are underutilized, either due to the lack of availability or due to poor perceptions of their effectiveness.

- With our staff of behavioral experts, we can help develop new methods of assessment, or perform objective and independent testing of any novel approaches and techniques to be included in SFST and DRE assessments.
- We can survey state toxicologists (nationally) to better understand differences in the processing of chemical analytical testing. This would be performed with the goal of identifying methods that reliably detect recent cannabinoid use (*delta*⁹THC and others).
- Our team of policy experts can provide consultation on the legislative and regulatory prerequisites for the adoption of new cannabis impairment technologies and benchmark this policymaking against other jurisdictions to streamline efficient rulemaking and preempt potential litigation.

Although the recommendations above involve current behavioral and chemical testing methods utilized by the State of New York, there are opportunities for us to assist in the development of nascent technologies. For instance:

- We are currently working with academic institutions (UCLA & UCSF), have relationships with and can work collaboratively with others named in this document to validate new digital technologies in experimental/lab environments. We have three behaviorally trained PhD's on staff with expertise in psychopharmacology and cannabinoid effects.
- The development of any new digital technologies can be furthered by using survey and crowdsourcing methods with large and diverse samples. Our in-house data scientists and experts in large-scale descriptive research can help to acquire neuropsychological assessment data from cannabis users across the State of New York or nationally.

Summary

We hope that the information provided in this report has provided helpful context and education. Our team would be pleased to provide additional information, research assistance, and/or public policy consultation in any area described above. We appreciate this opportunity to provide a response on this nuanced and urgent topic; as a team of public health and policy experts, cannabis impaired driving remains one of our leading critical concerns and we would welcome the opportunity to work directly on the issue with a state partnership.

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