Written Testimony of Paul Armentano,
Deputy Director
National Organization for the Reform of Marijuana Laws (NORML)
RE Senate Bill 833, Sec. 12.5-104

My name is Paul Armentano and **I am here to today to testify in support of striking language in Senate Bill 833 that seeks arbitrarily define cannabis-induced psychomotor impairment** in a manner that is neither evidence based nor in the best interest of public health and safety.

I voice these concerns today not only as a Maryland resident, but also as someone who has worked professionally in the field of marijuana policy, with a particular emphasis on the science specific to cannabis' effect on driving performance and traffic safety. My work on this issue has been highlighted in the peer-reviewed scientific literature and in various academic anthologies, and I have presented at numerous academic and legal symposiums on drugged driving.

I am a court certified expert on issues pertaining to cannabis and psychomotor performance, and I have attended many accredited educational forums on the topic, including those sponsored by the American Academy of Forensic Sciences (AAFS), the Society of Forensic Toxicologists (SOFT), the International Council on Alcohol, Drugs, and Traffic Safety (ICADTS), and the National Institute on Drug Abuse (NIDA). In 2021, I worked with state lawmakers in Nevada and Indiana to successfully amend their states' ineffective and problematic cannabis DUI laws.

I currently serve as the Deputy Director for the National Organization for the Reform of Marijuana Laws (NORML) – a public interest advocacy organization based in Washington, DC. While NORML supports the overall goal of SB 833 – to place the adult-use legalization question before voters and to establish a framework for a legal cannabis market – **we are concerned that the inclusion of a 5ng/ml *per se* traffic safety provision for THC will unduly criminalize adults who are not under the influence of cannabis and, thus, who pose no legitimate traffic safety risk.**

1

Leading Traffic Safety Experts Oppose *Per Se* Limits for Cannabis

It is well-established by leading experts in the field that neither *per se* limits for THC nor its metabolite are consistent or appropriate predictors of driving impairment. In fact, there is no legitimate debate on this issue.

Specifically, the premiere traffic safety agency in the United States, the National Highway Traffic Safety Administration (NHTSA), acknowledges: "It is difficult to establish a relationship between a person's THC blood or plasma concentration and performance impairing effects. ... **It is inadvisable to try and predict effects based on blood THC concentrations alone, and currently impossible to predict specific effects based on THC-COOH (metabolite) concentrations."**[1]

On-road driving performance studies coordinated by NHTSA confirm this conclusion, finding, "**One of the program's objectives was to determine whether it is possible to predict driving impairment by plasma concentrations of THC and/or its metabolite, THC-COOH, in a single sample. The answer is very clear: it is not.** Plasma of drivers showing substantial impairment in these studies contained both high and low THC concentrations; and, drivers with high-plasma concentrations showed substantial, but also no impairment, or even some improvement."[2]

A 2016 study conducted by the American Automobile Association (AAA) also concludes, "There is no evidence from the data collected, particularly from the subjects assessed through the DRE exam, that any objective threshold exists that established impairment, based on THC concentrations."[3]

---

[1] NHTSA. Drugs and Human Performance Fact Sheet: Cannabis/Marijuana
https://www.wsp.wa.gov/breathtest/docs/webdms/DRE_Forms/Publications/drug/Human_Performance_Drug_Fact_Sheets-NHTSA.pdf

[2] US DOT, NHTSA Final Report: Marijuana and Actual Driving Performance, page 107.
https://rosap.ntl.bts.gov/view/dot/1558

[3] AAA. *An Evaluation of Data from Drivers Arrested for Driving Under the Influence in Relation to Per Se Limits for Cannabis*. May 2016.
https://aaafoundation.org/wp-content/uploads/2017/12/EvaluationOfDriversInRelationToPerSeReport.pdf

A 2019 Congressional Research Service report, entitled *Marijuana Use and Highway Safety*, similarly determines: "**Research studies have been unable to consistently correlate levels of marijuana consumption, or THC in a person's body, and levels of impairment.** Thus, some researchers, and the National Highway Traffic Safety Administration, have observed that using a measure of THC as evidence of a driver's impairment is not supported by scientific evidence to date."[4]

Two recent state-appointed task forces on drugged driving – one in Michigan and another in California – have reaffirmed this position in recent months in their recommendations to lawmakers. In California, recommendations of a task force led by the California Highway Patrol concluded: "**Drugs affect people differently depending on many variables. A *per se* limit for drugs, other than ethanol, should not be enacted at this time as current scientific research does not support it.**"[5] In Michigan, a report from the state's Impaired Driving Safety Commission similarly concluded: "**[B]ecause there is a poor correlation between Δ9-THC bodily content and driving impairment, the Commission recommends against the establishment of a threshold of delta-9-THC bodily content for determining driving impairment.**"[6]

More recently, a literature review published online ahead of print in November in the journal *Neuroscience and Biobehavioral Reviews*, concluded, "**Blood THC, 11– OH-THC and 11– COOH-THC concentrations, oral fluid THC concentrations, and subjective ratings of intoxication are relatively poor indicators of cannabis-induced impairment. The use of *per se* limits as a means of identifying cannabis-impaired drivers should therefore be re-considered.**"[7] Similarly, driving simulator data published in January in the journal *JAMA Psychiatry* identified "**no correlation between**

[4] Congressional Research Service. *Marijuana use and Highway Safety*. May 14, 2019. https://crsreports.congress.gov/product/pdf/R/R45719

[5] CHP Impaired Driving Task Force, Report to the Legislature. January 2021 https://www.canorml.org/wp-content/uploads/2021/03/Senate-Bill-94-2017-CHP-Report-to-the-Legislature-Impaired-Driving-Task-Force-Report.pdf

[6] Report from the Impaired Driving Safety Commission. March 2019 https://www.michigan.gov/documents/msp/Impaired_Driving_Report_650288_7.pdf

[7] McCartney et al. 2022. Are blood and oral fluid THC and metabolite concentrations related to impairment? A meta-regression analysis. *Neuroscience and Biobehavioral Reviews*: https://pubmed.ncbi.nlm.nih.gov/34767878/

blood THC concentrations" and impairment of performance at any time, even under "highly controlled conditions."[8]

This is not a matter of "we need more study." This issue has been studied extensively and the results are clear and consistent. This reality is best summarized by Dr. Marilyn Huestis, who spent over 25 years studying this issue at the US National Institute on Drug Abuse and is one of the leading scholars in the world on the issue of cannabis and driving performance, who said: **"There is no one blood or oral fluid concentration that can differentiate impaired and not impaired. It's not like we need to say, 'Oh, let's do some more research and give you an answer.' We already know. We've done the research."**[9]

Why Are *Per Se* Limits Inadvisable for Cannabis?

There are several reasons why neither the identification of THC nor its metabolite is not well correlated with either driving impairment or recency of cannabis exposure.

First, THC possesses unique pharmacokinetics (absorption patterns). For example, when inhaled, THC/blood levels rise to maximal levels almost instantly, well before the onset of acute impairment.[10] These levels then begin to decline precipitously during the acute impairment phase. This relationship is the exact opposite of that of alcohol, in which rising BAC levels are consistently correlated with both the level of consumption and the degree of intoxication.

By contrast, when THC is consumed orally, THC blood levels barely rise at all – despite associated (and longer lasting) intoxication.

Second, because THC is lipid soluble, trace quantities of it may remain present in blood for days after past exposure – long after any intoxication has worn off.

---

[8] Marcotte et al. 2022. Driving performance and cannabis users' perception of safety: A randomized clinical trial. *JAMA Psychiatry*: https://jamanetwork.com/journals/jamapsychiatry/fullarticle/2788264
[9] https://www.eurekalert.org/pub_releases/2018-01/cp-dar011818.php
[10] Schwope et al. 2012. Psychomotor performance, subjective and physiological effects and whole blood delta-9- tetrahydrocannbinol concentrations in heavy, chronic cannabis smokers following acute smoked cannabis. *Journal of Analytical Toxicology*: 1-8.

Specifically, scientific studies have documented **the presence of residual quantities of THC in the blood of more frequent cannabis consumers at levels near or above SB 833's proposed standard for periods of time exceeding seven days**[11] – **long after any psychomotor impairing effects have long subsided.**[12] At present, there exists no technology that can differentiate between cannabis exposure that occurred within the past several hours versus exposure that occurred within the past several days.

Three, subjects' response to THC is much more variable than it is for alcohol. For example, experienced cannabis consumers – such as those patients legally protected under Maryland's existing medical cannabis law who consume it daily, tend to display little to no change in psychomotor performance following cannabis administration,[13] while more naïve may display changes in reaction time, brake latency, and in standard deviation of lateral positioning. Several papers in the scientific literature affirm this phenomenon of cannabis tolerance.[14] One literature review finds, "Patients who take cannabinoids at a constant dosage over an extensive period of time often develop tolerance to the impairment of psychomotor performance, so that they can drive vehicles safely."[15] **Similarly, the US Food and Drug Administration acknowledges persons acclimated to the effects of oral THC "are able to tolerate the drug and to perform such tasks safely."**[16]

In Conclusion:

The 5ng/ml THC *per se* threshold proposed in Senate Bill 833 (page 81) is not evidence-based; such *per se* thresholds for THC are opposed by the majority of experts in the field, and they will have the unintended result of criminalizing adults

---

[11] Odell et al. 2015. Residual cannabis levels in blood, urine and oral fluid following heavy cannabis use. *Forensic Science International*: 173-180.

[12] Ronen et al., 2008. Effects of THC on driving performance, physiological state and subjective feelings relative to alcohol. *Accident, Analysis and Prevention*: 926-934.

[13] Sewell et al., 2009. The effect of cannabis compared with alcohol on driving. *American Journal of Addiction*: 185- 193.

[14] Colizzi and Bhattacharyya. 2018. Cannabis use and the development of tolerance: A systematic review of human evidence. *Neuroscience & Behavioral Reviews*: 1-25.

[15] Grotenhermen and Muller-Vahl. 2012. The therapeutic potential of cannabis and cannabinoids. *Duetsches Arzteblatt International*: 495-501.

[16] Online at: http://www.fda.gov/ohrms/dockets/dockets/05n0479/05N-0479-emc0004-04.pdf

and patients who consume cannabis responsibly while in the privacy of their own home.

Accordingly, I urge lawmakers to amend SB 833 in a manner that eliminates the inclusion of this language.

Below are some helpful resources that I am including as a fact sheet for your ease of reference.

Per se thresholds for THC are not evidence-based and may result in inadvertently criminalizing adults who previously consumed cannabis several days earlier but are no longer under the influence.

Here is what the leading experts in the field have to say:

- "Drugs affect people differently depending on many variables. A per se limit for drugs, other than ethanol, should not be enacted at this time as current scientific research does not support it."
  California Highway Patrol Impaired Driving Task Force, Report to the Legislature, January 2021

- "Due to erratic and route-dependent differences in THC pharmacokinetics as well as significant inter- and intra-individual variability, blood and oral fluid THC concentrations, unlike BAC [blood alcohol concentrations] for alcohol, provide little information as to the amount of cannabis consumed or the extent to which an individual may be intoxicated. Collectively, these results suggest that the per se limits examined here do not reliably rep- resent thresholds for impaired driving."
  The failings of per se limits to detect cannabis-induced driving impairment: Results from a simulated driving study, Traffic Injury Prevention, 2021

- "[E]pidemiological evidence supporting a specific per se limit for THC is scant. ... Blood THC >2 ng/mL, and possibly even THC >5 ng/mL, does not necessarily represent recent use of cannabis in frequent cannabis users."

[Residual blood THC levels in frequent cannabis users after four hours of abstinence: A systematic review, Drug and Alcohol Dependence, 2020](#)

- "[T]he relationship between crash risk and the amount of cannabis consumed or the blood concentrations of THC is weak. … [B]lood concentration of THC is a poor index of driving-related risk or impairment."
[Strengths and limitations of two cannabis-impaired driving detection methods: a review of the literature, The American Journal of Drug and Alcohol Abuse, 2019](#)

- "[B]lood and other fluid levels of various cannabinoids correlate poorly with impairment. A person can have detectable cannabinoids, such as THC, in the blood or oral fluid, but not be cognitively impaired, since these levels may reflect on-going, low-level use, such as in medicinal cases, or a single use that occurred many hours or even days previously."
[Written testimony of Dr. Igor Grant, Director Center for Medicinal Cannabis Research, before the California Senate Committee on Labor, Public Employment and Retirement, November 8, 2019](#)

- "Research studies have been unable to consistently correlate levels of marijuana consumption, or THC in a person's body, and levels of impairment. Thus some researchers, and the National Highway Traffic Safety Administration, have observed that using a measure of THC as evidence of a driver's impairment is not supported by scientific evidence to date."
[Congressional Research Service, Marijuana Use and Highway Safety, 2019](#)

- "[B]ecause there is a poor correlation between Δ9-THC bodily content and driving impairment, the Commission recommends against the establishment of a threshold of delta-9-THC bodily content for determining driving impairment."
[Report from the Michigan Impaired Driving Safety Commission, March 2019](#)

- "To contribute to the ongoing discussion about threshold limits of Δ9-tetrahydrocannabinol (THC) in road traffic, a driving simulator study with 15 habitually cannabis consuming test persons was conducted. … Consistent with previous studies, a direct correlation between the individual fitness to drive (amount of penalty points) and the THC concentrations … was not found. Therefore,

determining a threshold limit for legal purposes based on these values alone seems to be arbitrary."
[On the impact of cannabis consumption on traffic safety: a driving simulator study with habitual cannabis consumers, International Journal of Legal Medicine, 2019](#)

- "Unlike alcohol, blood levels of THC do not reflect intoxication."
[Statement of Dr. Daniele Piomelli, professor of anatomy and neurobiology at the University of California, Irvine, March 1, 2019](#)

- "[B]lood THC levels drop very sharply over time-periods measured in minutes. Blood THC is not a good proxy either for recency of use or for impairment, and the dose-effect curve for fatality risk remains a matter of sharp controversy. ... Moreover, the lipid-solubility of THC means that a frequent cannabis user will always have measurable THC in his or her blood, even when that person has not used recently and is neither subjectively intoxicated nor objectively impaired."
[Driving while stoned: Issues and policy options, BOTEC Analysis/SSRN white paper, 2018](#)

- "Current evidence shows that blood levels of tetrahydrocannabinol do not correlate well with the level of impairment."
[Driving under the influence of cannabis: A framework for future policy, Anesthesia and Analgesia, 2018](#)

- "It is difficult to establish a relationship between a person's THC blood or plasma concentration and performance impairing effects. ... It is inadvisable to try and predict effects based on blood THC concentrations alone, and currently impossible to predict specific effects based on THC-COOH (metabolite) concentrations."
[US National Highway Traffic Safety Administration, Drugs and Human Performance online factsheet](#)

- "The interpretation of cannabinoid effects is even more difficult than identifying the presence or concentration of natural or synthetic cannabinoid markers in a diverse array of biological samples. Interpretation is complex because the onset, peak, and duration of effects are different based on whether the route of cannabis administration is inhalation, oral, or rectal, and on whether the individual is an

occasional or chronic frequent cannabis users. …. Currently, science does not support the development of cannabinoid limits per se in motor vehicles drivers because of the many factors influencing concentration–effect relationships."
Cannabinoid markers in biological fluids and tissue: Revealing intake, Trends in Molecular Medicine, 2018

- "There is no one blood or oral fluid concentration that can differentiate impaired and not impaired. It's not like we need to say, 'Oh, let's do some more research and give you an answer.' We already know. We've done the research."
Statement of Marilyn Huestis, who spent over 20 years leading cannabinoid-related research projects at the US National Institute on Drug Abuse, January 25, 2018

- "Simply identifying cannabis use in a driver is not enough to justify the assumption of an increased risk for UTEs (unfavorable traffic events)."
The association of unfavorable traffic events and cannabis usage: A meta-analysis, Frontiers in Pharmacology, 2018

- "A quantitative threshold for per se laws for THC following cannabis use cannot be scientifically reported."
American Automobile Association, An Evaluation of Data from Drivers Arrested for Driving Under the Influence in Relation to Per Se Limits for Cannabis, 2016

- "The alcohol laws are based on evidence concerning the decreased ability of drivers across the population to function safely at these BACs. … Such evidence is not currently available for concentrations of other drugs."
US National Highway Traffic Safety Administration, Understanding the Limitations of Drug Test Information, Reporting, and Testing Practices in Fatal Car Crashes, 2014

- "There is no direct correlation between driving impairment and THC concentration"
Cannabis effects on driving skills, Clinical Chemistry, 2013

- "Individuals can vary widely in their sensitivity to THC induced impairment as evinced by the weak correlations between THC in serum and magnitude of performance impairment."
  [Dose related risk of motor vehicle crashes after cannabis use: an update, 2009](#)

- "One of the program's objectives was to determine whether it is possible to predict driving impairment by plasma concentrations of THC and/or its metabolite, THC-COOH, in single samples. The answer is very clear: it is not. Plasma of drivers showing substantial impairment in these studies contained both high and low THC concentrations; and, drivers with high plasma concentrations showed substantial, but also no impairment, and even some improvement."
  [US National Highway Traffic Safety Administration, Marijuana and Actual Driving Performance, 1993](#)