LEGISLATIVE REPORT: SPECIAL COMMISSION ON OPERATING UNDER THE INFLUENCE

Report to the Clerks of the House of Representatives and the Senate

January 1, 2019

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Legislative Report on Operating Under the Influence and Impaired Driving

I. INTRODUCTION

This report is submitted in accordance with Section 50 of Chapter 55 of the Acts of 2017, *An Act to Ensure Safe Access to Marijuana* (**the Act)**, which creates a Special Commission on Operating Under the Influence and Impaired Driving, (**the Special Commission**). Under the law, the Special Commission is instructed to "conduct a comprehensive study relative to the regulation and testing of operating under the influence of marihuana, narcotic drugs and depressant or stimulant substances all as defined in section 1 of chapter 94C of the General Laws," as well as "review all aspects of law enforcement personnel ability to properly test impaired operators and prevent impaired operation of motor vehicles." The following report satisfies Section 50 of the Act, specifically that the Special Commission "submit its final report and any recommendations for legislation" with the Clerks of the House of Representatives and the Senate on or before January 1, 2019.

Consistent with the mandate, the Special Commission studied and provides recommendations relative to the following areas:

(i) scientific types of testing and data;
(ii) medical types of testing and data;
(iii) possible new technological forms of testing;
(iv) civil liberties of the operator;
(v) social economic aspects of the testing;
(vi) admissibility of evidence of impaired driving in court proceedings;
(vii) burden on law enforcement;
(viii) training of law enforcement;
(ix) intrusiveness of tests;
(x) cost analysis of testing;
(xi) the current threshold for determining impairment; and
(xii) the rate of success in stopping impaired operators.

II. BACKGROUND & HISTORY

On November 8, 2016, Ballot Question 4 "Legalize Marijuana" passed with 53.6% of the vote. At that time, Massachusetts joined seven other states, in addition to the District of Colombia, which legalized marijuana for adult-use (i.e. recreational use). The resulting law, Chapter 334 of the Acts of 2016, *The Regulation and Taxation of Marijuana Act*, and was amended by Chapter 55 of the Acts of 2017, *An Act to Ensure Safe Access to Marijuana.*

The Special Commission consisted of 13 appointed members, as established in subsection (b) of said Section 50 of Chapter 55 of the Acts of 2017. Members convened for the first meeting on June 13, 2018 and has met regularly since.

The Special Commission included the following members:

- Shawn Collins, Executive Director, Cannabis Control Commission, Chair
- Dr. Margarita Alegria, appointed by the Secretary of Health and Human Services
- Matt Allen, appointed by the American Civil Liberties Union (ACLU) of Massachusetts
- Jennifer Queally, Undersecretary for Law Enforcement, appointed by the Secretary of Public Safety and Security
- John Carmichael, Walpole Chief of Police, appointed by Massachusetts Chiefs of Police
- Dr. Alan Ehrlich, appointed by the Massachusetts Medical Society
- Peter Elikann, Esq., appointed by the Massachusetts Bar Association
- Lt. Detective Ken Halloran, appointed by Colonel of Massachusetts State Police
- Sabra Botch Jones, appointed by Governor Charlie Baker
- The Honorable Judge Robert Kane (Ret.), designee of District Attorney Thomas Quinn
- Mary Maguire, appointed by American Automobile Association (AAA) Northeast
- John Scheft, Esq., appointed by the Attorney General
- Stephanie Soriano, Esq., appointed by the National Association for the Advancement of Colored People Northeast (NAACP NE) Area Conferences

The Special Commission heard presentations from subject matter experts, ranging from the statewide Drug Recognition Expert coordinator, to law enforcement, to a presentation on the state of medical and testing research (See Appendix A). The Special Commission reviewed over a dozen reports, including the Massachusetts State Police Oral Fluid Drug Testing report and several AAA studies from Colorado and Washington.

III. THE CURRENT STATE OF MASSACHUSETTS LAW

Legal Background: Massachusetts

Massachusetts has now enacted and implemented three types of cannabis legalization in various waves. Each wave of legalization has been approved via ballot initiatives: cannabis decriminalization in 2008 with Question 2, "*The Sensible Marijuana Policy Initiative*," medicinal cannabis in 2012 with Question 3, "*An Initiative Petition for a Law for the*

Humanitarian Medical Use of Marijuana," and non-medical adult-use cannabis legalization in 2016 with Question 4, "*Massachusetts Legalization, Regulation and Taxation of Marijuana Initiative.*"

Other important laws in the discussion on cannabis-impaired driving in Massachusetts are the implied consent law and a recent decision by the Massachusetts Supreme Judicial Court, Commonwealth v. Thomas Gerhardt, 477 Mass. 775, 81 N.E.3d 751 (2017).

Implied Consent Law G.L. c. 90, § 24

Under the Massachusetts implied consent law,[1] a driver arrested by a law enforcement officer who has probable cause to believe that he/she has been operating a motor vehicle while impaired, must submit to a chemical test of blood or breath to determine their Blood Alcohol Content (**BAC**). If the suspected driver refuses to take the chemical test of the arresting officer's choice, their license is immediately suspended for a predetermined duration of time. The time of license suspension varies based on the age of the driver (*i.e. drivers aged 21 or older vs. minors aged 20 years old or younger*) and the number of prior offenses. If the driver is an adult 21-years-old or older, the license suspension is 180 days for first offense (*i.e. refusal and with no prior offense*), three years for second offense (*i.e. refusal and a prior conviction for driving while under influence of intoxicating liquor*), five years for third offense (*i.e. refusal and two prior convictions*), and for life if three or more offenses (*i.e. refusal and three or more prior convictions).* If the driver is under the age of 21, the license suspension is three years for first offense, five years for the second offense, and for life for the third offense.

There is currently no similar implied consent law for drugged-impairment in Massachusetts. This means if a driver is suspected of driving while impaired under the influence of an intoxicating substance other than alcohol, the driver can refuse a test with no license suspension implications.

Commonwealth v. Thomas Gerhardt

In a prosecution for operating while under the influence of cannabis (**OUI**), it is the Commonwealth's burden to prove beyond a reasonable doubt, that a defendant's consumption of cannabis impaired his or her ability to drive a motor vehicle safely. In a recent decision by the Massachusetts SJC, Commonwealth v. Gerhardt, a motorist was charged with operating a vehicle under the influence of cannabis, in violation of G. L. c. 90, § 24. A motion was filed for a

[1] Commonwealth of Massachusetts. *General Law Chapter 90, Section 24: Driving While under Influence of Intoxicating Liquor, Etc.; Second and Subsequent Offenses; Punishment; Treatment Programs; Reckless and Unauthorized Driving; Failure to Stop after Collision.*

Daubert-Lanigan hearing, seeking to challenge the admissibility of evidence concerning his performance on field sobriety tests conducted after the stop.[2]

The SJC held that in a prosecution for operating a motor vehicle while under the influence of cannabis: "*police officers may not testify to the administration and results of field sobriety tests (FSTs) as they do in operating while under the influence of alcohol prosecutions*," but "*may testify to the administration of 'roadside assessments*;'" that a "*lay witness may not offer an opinion that another person is 'high' on marijuana* ("cannabis");" that a "*police officer may testify to observed physical characteristics of the driver such as blood shot eyes, drowsiness, and lack of coordination*," but may not "*offer an opinion that these characteristics mean that the driver is under the influence of marijuana* ('cannabis');" and that the jury may "*utilize their common sense*" in deciding if the driver's performance on the roadside assessments indicates his or her ability to operate a motor vehicle safely was impaired.[3]

Following this decision, a law enforcement officer may testify to observations made during the administration of roadside assessments to the extent that they are relevant to establish a driver's balance, coordination, mental acuity, and other skills required to safely operate a motor vehicle. However, the officer may not testify, on direct examination, that a driver's performance on an assessment established that the driver was under the influence of marijuana or cannabis, or that an individual "passed" or "failed" any assessment.[4]

IV. OTHER STATES' APPROACHES TO OPERATING UNDER THE INFLUENCE OF DRUGS

To address drugged driving, every state has a law that in some manner deals with the issue. The table below looks at the laws of states and Washington D.C. where, as with Massachusetts, both medical-use and adult-use (i.e. recreational) cannabis are legalized as of the date of this report.

Of the states that have legalized both medical-use and adult-use cannabis, two states – Nevada, and Washington – presently impose per se limits for the detection of specific amounts of Tetrahydrocannabinol (THC), the psychoactive chemical in cannabis, in blood, while one state (Michigan) imposes zero tolerance per se standards. Under Michigan's zero tolerance law, a prosecutor must only show that cannabis was present, in any amount, in the driver's blood, and need not show that these drugs caused intoxication or impairment; except, where an individual has a valid medical marijuana card and is driving with cannabis in his or her system, an officer must show they are impaired due to that cannabis. Colorado imposes a permissible inference

[2] Commonwealth v. Gerhardt, 477 Mass. 775, 81 N.E.3d 751 (2017).
[3] Id.
[4] Id.

standard, where the presence of THC in blood above 5ng/ml gives rise to a permissible inference that the defendant was under the influence of cannabis. This inference is rebuttable by the defendant. In the other states (Alaska, California, Maine, Oregon, Vermont) and Washington D.C., while there is no legal limit of THC while operating a vehicle, intoxication or impairment must be demonstrated to find a violation of driving under the influence (DUI) of cannabis.

The table below also includes information about these states' implied consent laws as they pertain to the testing of cannabis. All states listed below, except for one (Alaska), extend their implied consent laws (to provide specimen if requested by law enforcement) to driving under the influence of drugs (DUID). Massachusetts is amongst those five states that do not have an implied consent law for drug-impaired driving. In Alaska, there is a provision for mandatory testing in cases involving serious injury or fatal crashes. In states that extend their implied consent laws to drugged driving, drivers face penalties for refusal to take a test for the presence of drugs in their bodies. In the five states that do not have implied consent laws for drugged driving, including Alaska and Massachusetts, drivers are not required to submit to testing for drugs where they are suspected of driving while impaired by or under the influence of drugs.

Finally, the table below considers the various approaches officers in those states are taking to detect cannabis-impaired driving. Typically, the detection of driving while impaired by drugs takes place as a result of an officer's observation of impaired driving behavior. After pulling over the driver, the officer may engage the driver in some pre-arrest screening tests, which may include a preliminary breath test to determine whether the driver's blood alcohol content (**BAC**) is within the legal limit. In many jurisdictions, the investigation stops where the driver's BAC is above the legal limit, even if the driver's impairment could be due to a combination of alcohol and a drug(s), and the driver is cited or arrested. Where a driver's BAC level is below the legal limit and the officer observed impairment, the officer may arrest the driver for suspicion of impaired driving. In jurisdictions participating in the Drug Evaluation and Classification (**DEC**) Program, the arresting officer may request an evaluation by a Drug Recognition Expert (**DRE**). Currently, all 50 states and the District of Columbia participate in the DEC Program.[5] Generally after arrest, the officer or the DRE may request testing of blood, breath, urine and/or saliva depending on the type of testing used in a jurisdiction. There is no breath test for cannabis, but in some states, a driver may be required to submit to one anyway for the detection of alcohol if an evidential breath test device is available in the field. There are limited roadside testing options available for the detection of cannabis; and in many instances, specimen is taken at the station or a hospital and subsequently sent to a lab for testing. Two states out of the states listed below (California and Michigan) have piloted roadside saliva drug testing programs that analyze saliva swabs for cannabis and other drugs. Earlier this year in

[5] *Drug Recognition Experts (DREs)*, Int'l Assoc. of Chiefs of Police, https://www.theiacp.org/drug-recognition-experts-dres

Vermont, a bill authorizing police to screen for the presence of cannabis using a saliva sample rather than a blood sample was blocked.

Table: States with Legalized Medical-Use and Adult-Use Marijuana and Their Approaches to Cannabis-Impaired Driving

	Legal Limit for Cannabis Impairment While Driving?	**Is Implied Consent Law Extended to Testing of Cannabis?**	**Cannabis-Impaired Driving Detection Process**
Alaska[6]	No But a driver must be under the influence of or impaired by THC	No Unless the accident causes death or serious injury, then there is implied consent for blood or urine tests for any controlled substances	Observation; for a breath test, if BAC is below .08; observation that the driver is under the influence of cannabis or other drugs.

[6] Alaska Stat. 28.35.031. Implied Consent; 28.35.035. Administration of Chemical Tests Without Consent; *Driving High is a DUI Fact Sheet*, Alaska Dept. of Health and Social Services, Division of Public Health, http://dhss.alaska.gov/dph/Director/Documents/marijuana/MJFactSheet_DUI.pdf; Scott Woodham, *How do Alaska police test for marijuana in drivers suspected of DUI?*, Anchorage Daily News, Sep. 28, 2016, https://www.adn.com/highly-informed/article/alaska-dui-question-will-i-have-wait-month-after-smoking-pot-driving/2015/04/09/

	Legal Limit for Cannabis Impairment While Driving?	Is Implied Consent Law Extended to Testing of Cannabis?	Cannabis-Impaired Driving Detection Process
California[7]	No But the driver must be under the influence of or impaired by THC	Yes To submit to a chemical test of blood or urine; no exceptions for lawful medical cannabis patients Drivers may choose between a blood or urine test, but do not have the right to consult an attorney before submitting to the test.	If the driver's BAC is below applicable "legal limit" but the driver still appears intoxicated, an officer may suspect drug use. The officer might then call a DRE to come to the scene to conduct 12-step evaluation. Not all California counties have DREs, so the driver suspected of DUID may or may not be subject to a DRE evaluation. Some jurisdictions in California are also testing the use of a mouth-swab device for the presence of THC at various DUI checkpoints.
Colorado[8]	5 ng of active THC in blood gives rise to a permissible inference of driving while impaired	Yes To take a chemical test of blood, breath, saliva, or urine	No roadside device to detect THC, so an officer can base arrests on observed impairment. Officers are trained in the detection of impairment caused by drugs, of which some are trained in Advanced Roadside Impaired

[7] Vehicle Code 23152(c), (f), (g); Shouse California Law Group, *Driving Under the Influence of Drugs (DUID) California Vehicle Code 23152(f) and 23152(g), available at* https://www.shouselaw.com/dui-drugs.html; Kristina Davis, *Police are using new mouth-swab tests to nab drivers under the influence of marijuana and other drugs*, L.A. Times, Mar. 17, 2017, https://www.latimes.com/local/lanow/la-me-mouth-swab-drugs-test-police-pot-20170317-story.html

[8] Colorado Revised Statute 42-4-1301 – Driving under the influence, 42-4-1301.1 – Expressed consent for the taking of blood, breath, urine, or saliva sample; *Colorado Drunk Driving Laws*, Office of Legislative Legal Services, https://leg.colorado.gov/sites/default/files/colorado-drunk-driving-laws.pdf; *Drugged Driving*, Colorado Dept. of Transportation, https://www.codot.gov/safety/alcohol-and-impaired-driving/druggeddriving/safety/alcohol-and-impaired-driving/druggeddriving; FAQs: Cannabis and Driving, Colorado Dept. of Transportation, https://www.codot.gov/safety/alcohol-and-impaired-driving/druggeddriving/marijuana-and-driving

	Legal Limit for Cannabis Impairment While Driving?	Is Implied Consent Law Extended to Testing of Cannabis?	Cannabis-Impaired Driving Detection Process
			Driving Enforcement (**ARIDE**). Across the state, enforcement agencies have specially trained DRE on staff that can detect impairment from various substances. DREs may subject drivers to chemical tests of the blood, breath or urine.
Maine[9]	No But driver must be under the influence of or impaired by THC	Yes To determine the presence of a drug or drug metabolite by analysis of blood, breath or urine	Firsthand observation; if BAC is below legal limit, use DRE-trained police officer to conduct 12-step analysis, who may subject the driver to breath, blood or urine tests. The presence of abused drugs or controlled substances in the system can be used as evidence of impairment.
Michigan[10]	No	Yes	

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[9] Maine Revised Statutes § 2521 – Implied consent to chemical tests; *Driving & Drugs in Maine*, Dept. of Public Safety, Bureau of Highway Safety, https://www.maine.gov/dps/bhs/impaired-driving/drugs.html; *Drug Recognition Expert Course*, Nat'l Highway Traffic Safety Administration, rev. Feb. 2018, https://www.maine.gov/dps/bhs/impaired-driving/dre/documents/2018DRE7-DayFullParticipantManual.pdf; Bill Nemitz, *What are the rules of the road for marijuana?*, Portland Press Herald, Jan. 21, 2018, https://www.pressherald.com/2018/01/21/nemitz-what-are-the-rules-of-the-road-for-marijuana/

[10] Michigan Vehicle Code § 257.625a; 257.625c - Consent to chemical tests; *Michigan's Law*, Department of State, https://www.michigan.gov/sos/0,4670,7-127-1627_8665_9070-21485--,00.html; Impaired Driving Law, Michigan State Police, https://www.michigan.gov/msp/0,4643,7-123-72297_64773_22774-75633--,00.html; *Roadside Drug Testing Pilot Begins Nov. 8 in Five Counties*, Michigan State Police, Nov. 2, 2017, https://www.michigan.gov/msp/0,4643,7-123-1586_1710-451333--,00.html; Mary Beth Spalding, *Test targets drug-impaired driving in Michigan*, South Bend Tribune, Nov. 27, 2017, https://www.southbendtribune.com/news/local/test-targets-drug-impaired-driving-in-michigan/article_cfebad71-718c-51f0-a8fc-951883445b87.html; Kate Wells, *What you need to know about the new roadside drug tests*, Michigan Radio, Nov. 8, 2017, http://www.michiganradio.org/post/what-you-need-know-about-new-roadside-drug-tests

	Legal Limit for Cannabis Impairment While Driving?	Is Implied Consent Law Extended to Testing of Cannabis?	Cannabis-Impaired Driving Detection Process
	Zero tolerance law: Any amount of cannabis in system is guilty of DUI (except officer must show impairment where driver has valid medical marijuana card)	To chemical tests of blood, breath, or urine (and saliva under a pilot program) to determine presence of a controlled substance	Observation; if there is a breath test or saliva test under pilot program; if arrested, then 12-step evaluation by DRE, who may subject drivers to breath, blood or urine tests. Starting in November 2017, Michigan piloted in five counties a new roadside drug test that analyzes saliva swabs for cannabis and other drugs, to be administered only by DREs.
Nevada[11]	Yes (per se limits) 2 ng/ml marijuana or 5 ng/ml marijuana metabolite in blood 5 ng/ml marijuana or 15 ng/ml marijuana metabolite in urine	Yes To tests of breath, blood or urine within 5 hours after arrest	Observation; with a breath test, if BAC is below legal limit, further investigation that may involve field sobriety tests, DRE evaluation; if establish probable cause that driving under influence of cannabis, arrest driver and bring to station for blood or urine test

[11] Nev. Rev. Stat. Ann. § 484C.110 Unlawful Acts; § 484C.120 Driving Under the Influence of Alcohol or a Prohibited Substance - Unlawful acts; § 484C.160 - Implied consent to evidentiary test; *DUI of Marijuana in Nevada law (NRS 484C.110)*, https://www.shouselaw.com/nevada/dui/dui-marijuana.html#2

	Legal Limit for Cannabis Impairment While Driving?	Is Implied Consent Law Extended to Testing of Cannabis?	Cannabis-Impaired Driving Detection Process
Oregon[12]	No But driver must be under the influence of affected by THC	Yes To a chemical test of urine to determine the presence of cannabis, if arrested for DUI of intoxicants and either (a) breath test discloses BAC of less than 0.08%; or (b) In accident resulting in injury or property damage, urine test may be requested regardless of results of a breath test and regardless of whether a breath test has been taken at all	Firsthand observation; if BAC is below legal limit, but suspects impairment, arrest the driver, call in DRE who conducts 12-step analysis to decide whether the driver is impaired by cannabis, some other drug or a medical condition, and may request a urine test. Before requesting urine test, an officer must have reasonable suspicion that driver was DUI of controlled substance and have the driver under arrest, and must have already successfully completed training and be certified by Dept. of Public Safety Standards and Training.
Vermont[13]	No	Yes	Observation, there is a breath test to detect alcohol. If BAC is below .08, and officer

[12] ORS 813.131 Implied consent to urine test; privacy; laboratories for analysis, https://www.oregonlegislature.gov/bills_laws/ors/ors813.html; Tiffany Eckert, *Pot May Be Legal To Use In Oregon But Buzzed Driving Can Still Get You Busted*, KLCC, Sep. 18, 2018; Ian K. Kullgren, *Marijuana and driving: What you need to know (FAQs)*, OregonLive.com, Jull. 1, 2015, https://www.oregonlive.com/politics/index.ssf/2015/07/marijuana_and_driving_what_you.html

[13] 23 V.S.A. § 1201 - Operating vehicle under the influence of alcohol or other substance; § 1202 – Consent to taking of tests to determine blood alcohol content or presence of other drug; *Impaired Driving (Alcohol and Drugs)*, Vermont Agency of Transportation, Governor's Highway Safety Program, https://ghsp.vermont.gov/programs/impaired-driving; April McCullum, *Roadside marijuana test blocked by key Vermont Senate committee*, Burlington Free Press, Jul. 1, 2018, https://www.burlingtonfreepress.com/story/news/politics/government/2018/05/02/saliva-testing-bill-blocked-vt-senate-committee/574122002/; Jordan Cuddemi, *Vermont's 'Drug Recognition Experts' Are Met With Skepticism*, Valley News, Sep. 15, 2018, https://www.vnews.com/Vermont-Drug-Recognition-Experts-and-How-They-Operate-20119533

	Legal Limit for Cannabis Impairment While Driving?	Is Implied Consent Law Extended to Testing of Cannabis?	Cannabis-Impaired Driving Detection Process
	But the driver must be under the influence of or impaired by THC	To the taking of a sample of blood, if officer has reasonable grounds to believe that driver is under the influence of a drug other than alcohol. Warrant is required.	believes driver is impaired, then an officer will bring driver into station, where DRE may be called to the scene to determine whether the driver under the influence of drugs using a 12-step evaluation; if drug impairment is determined, DRE may request blood test. Earlier this year, bill authorizing police to screen for presence of cannabis using a saliva sample rather than a blood sample failed to pass.
Washington[14]	5 ng (per se limit) (Any amount if under 21 years old)	Yes To providing a blood sample after arrest	Observation, when there is usually a breath test to detect alcohol, if BAC is below .08, DRE may be called to the scene. If determination made that that impairment is due to drugs other than alcohol, an officer is likely to arrest person and taken into station for a blood test performed at the station or a medical facility.

[14] Rev. Code. Wash. 46.20.308 – Implied Consent; 46.61.502 - Driving under the influence; Washington State Liquor and Cannabis Board, *Marijuana Education, Safety*, https://lcb.wa.gov/mj-education/safety

	Legal Limit for Cannabis Impairment While Driving?	Is Implied Consent Law Extended to Testing of Cannabis?	Cannabis-Impaired Driving Detection Process
Washington DC[15]	No But driver must be under the influence of or impaired by THC	Yes To chemical testing of blood, breath, or urine, for the purpose of determining drug content	Observation; if an officer has reasonable grounds to believe driver is impaired, the officer may request preliminary breath test or arrest driver; after arrest, may request chemical testing of blood, breath, or urine.

[15] § 50–1904.01. Preliminary breath test; § 50–1904.02. Chemical testing after arrest; § 50–2206.11 Driving under the influence (DUI) of alcohol or a drug;

V. THE CURRENT STATE OF THE RESEARCH

In recent years, there have been increasing concerns over the potential consequences of marijuana use, including cannabis-impaired driving in the United States (**U.S.**), categorized as a serious and growing threat to public safety. This concern is heightened with the enactment and implementation of cannabis policies across the U.S. However, the overall scope of the issue is difficult to assess. It has been challenging to get accurate estimates of cannabis use and driving as well as valid and reliable mechanisms to detect cannabis impairment or detect cannabinoids and their metabolites to infer a threshold of cannabis impairment.

The 2017 National Survey on Drug Use and Health (**NSDUH**) study reports that behind alcohol, cannabis ("marijuana") is the most widely used drug in the U.S.— with 44% of the population aged 12 years old or older reporting lifetime cannabis use and 9.6% reporting past month ("current") cannabis use. The Monitoring in the Future (**MTF**) study assesses substance use in youth and reports that 22.9% of 12th graders report current cannabis use and 5.9% report daily, which is regarded as heavy use, while the rates of perception of harm have steadily decreased.

Assessing and preventing cannabis-impaired driving in a top priority for Massachusetts with the recent implementation of licensed retail establishments permitting the sale of cannabis to adults 21 years old or older in the Commonwealth. The Massachusetts Cannabis Control Commission is currently conducting a comprehensive review of the scope of the problem, including the state of the science and baseline data to better understand the complexity of this issue and make evidence-based recommendations.

VI. RECOMMENDATIONS FROM THE SPECIAL COMMISSION

Members submitted recommendations to the Special Commission for consideration, which are found in their entirety in Appendix B. The recommendations were discussed and voted on across two meetings of the Special Commission held on December 21 and December 28, 2018. Recorded votes on recommendations are found in Appendix C.

1. The Special Commission accepts the findings of research which establish that the ingestion of THC can and does cause impairment in motorists. THC impairs motor function, reaction time, tracking, cognitive attention, decision-making, judgment, perception, peripheral vision, impulse control, and memory. Ingestion of THC does not enhance a motorist's ability to safely operate a vehicle. | *Voted: 9-0*
2. The Legislature should adopt a statute authorizing courts to take judicial notice relative to Recommendation 1. | *Voted: 9-0*
3. The Special Commission, or a similar commission, should be continued. It should meet regularly to study, review, and evaluate the reliability of oral fluid and other testing, as well as the practical availability of experts. This continued evaluation should be

supported with adequate funding and the Special Commission should be required to report periodically on its progress. | *Voted: 9-0*

4. Within the coming year, educational materials and programming should be made available to, and in collaboration with, the Massachusetts Judges Conference, relative to the Drug Recognition Expert program. This training should be developed collaboratively by the National Highway Traffic Safety Administration (NHTSA), the Commonwealth's Highway Safety Division, the Massachusetts Chiefs of Police Association, and the Commonwealth's statewide DRE coordinator. | *Voted: 9-0*
5. The Commonwealth should train a minimum of 351 Drug Recognition Experts, as well as several DREs to be deployed by the Massachusetts State Police. | *Voted: 8-0*
6. The Legislature should amend the existing open-container of alcohol law (G. L. c. 90, § 24I), to include cannabis. Currently, open-container of cannabis is governed by G. L. Ch. c. 94G, § 13(d), which requires any violation to be written on a ticket specific to that municipality. The Special Commission does not recommend modifying the penalties for the civil offense but recommends that the violation be written as a civil motor vehicle citation, similar to that of open-container of alcohol. | *Voted: 10-0*
7. The Legislature should adopt a statute allowing Drug Recognition Experts to testify as expert witnesses, thus allowing them to testify in court regarding their evaluations and findings. | *Voted: 8-1 (ACLU opposed)*
8. The Commonwealth should ensure that all police officers, through the Municipal Police Training Committee, be Advanced Roadside Impaired Driving Enforcement (ARIDE) certified, with funds for training and any related expenses to come from the Marijuana Regulation Fund. | *Voted: 8-0*
9. Consistent with current law regarding breath or blood testing for suspected alcohol impairment (G. L. c. 90, § 24), the Legislature should enact implied consent to oral fluid, breath or evaluation by a Drug Recognition Expert for suspected drugged driving, with the loss of license as the incentive to compliance. *(Voted: 8-1, ACLU opposed)* In the case of an evaluation by a Drug Recognition Expert, the implied consent should reflect only those non-testimonial elements of the examination. *(Voted: 8-1, ACLU opposed)*
10. The Legislature should adopt a statute recognizing, consistent with a resolution adopted by the American Optometric Association, the effectiveness and validity of the horizontal gaze nystagmus (HGN) test, and further enable a properly administered test to be admissible upon testimony of the officer without requiring the use of expert testimony. | *Vote: 8-2 (ACLU and Atty. Elikann opposed)*
11. To reduce delays in securing accurate and timely samples, the Legislature should amend the law (G. L. c. 276, § 2B) to permit electronic warrants, accompanied by sworn affidavits, for the collection of oral fluid or blood samples. | *Voted: 9-1 (ACLU opposed. In dissent, ACLU proposed that warrants should only be authorized by judges, as opposed to both magistrates and judges)*
12. The Legislature should facilitate the use of judicially authorized search warrants to efficiently and humanely acquire blood samples in order to test for drugs and alcohol by

requiring that hospitals or other entities licensed or authorized to draw blood in the Commonwealth comply with the request to do so, that said facility be compensated at a rate set by the Commonwealth but consistent with the rate for any walk-in patient, and that the professional and facility be protected from liability. | *Voted: 10-0*

13. The Commonwealth should continue to develop and fund public awareness and education campaigns outlining the dangers of impaired driving, in addition to the safe and responsible use of cannabis. | *Voted: 10-0*
14. The Commonwealth should add a drug impaired driving module to the drivers' education curriculum. | *Voted: 10-0*
15. All marijuana establishments should continue to be required to provide educational materials to consumers, and those materials should include messaging relative to the dangers of impaired driving and the imposition of penalties. | *Voted: 9-0*
16. The Legislature should amend the operating under the influence (OUI) statute (G. L. c. 90, § 24) to require proof only that a motorist was operating under the influence of alcohol or any substance, similar statutes in California and New Hampshire. Current law requires the Commonwealth to prove, beyond a reasonable doubt, not just that a motorist was impaired by a substance (alcoholic beverage, marijuana, a narcotic drug, a stimulant or depressant, or the toxic fumes of any substance), but the category of the substance that caused the impairment. This burden to prove the specific category – and not just impairment – does not take into account that motorists may be under the influence of multiple substances and fails to further the interests of justice. | *Voted: 10-0*
17. The Commonwealth should reverse the Appeals Court's decision in Commonwealth v. Shellenberger, 64 Mass. App. Ct. 70, 76 (2005), which suggested that evidence of the presence of a drug in a defendant's system requires evidence of the concentration of the drug as a precondition to admissibility. Although several unpublished opinions have rejected this argument, this case has not been overruled. The Legislature should amend the OUI statute clarifying that the absence of concentration evidence in an OUI case goes to the weight of the evidence, and not to its admissibility. | *Voted: 10-0*
18. The Legislature should amend the OUI statute (G. L. c. 90, § 24) to eliminate the requirement that a motor vehicle must be operated on "a public way." Impaired operation can occur in a variety of non-public environments (i.e. gated communities, fields, campsites, etc.) and should not be limited unnecessarily. | *Voted: 9-0-1 (ACLU abstention)*
19. The Legislature should amend the statute pertaining to motor vehicle traffic stops (G. L. c. 90, § 25), to require that, when asked, motorists roll down their window to facilitate an interaction with the officer. | *Voted: 8-1 (ACLU opposed)*

VI. CONCLUSION

The Special Commission is pleased to provide this report relative to operating under the influence and impaired driving. The recommendations above attempt to balance respect for the civil liberties of operators, as well as the public safety needs of the Commonwealth. The most effective means to deter impaired driving is to stop it from happening in the first place. That is why the Special Commission has placed special emphasis on encouraging and continuing robust public awareness and education campaigns, as well as ongoing dialogue amongst the many parties that have a stake in the public health and safety of all Massachusetts residents.

VII. APPENDICES

A. Recommendations Submitted by Members of the Special Commission
B. Special Commission Minutes and Recorded Votes
C. Presentations to the Special Commission

Appendix A: Recommendations Submitted by Members of the Special Commission

RECOMMENDATIONS FROM THE SPECIAL COMMISSION (PENDING VOTES)

A. Recommendations by the Massachusetts District Attorney's Association District (Attorney Tom Quinn and Judge (Ret.) Robert Kane)

1. The initial recommendation proposes review by Committee members of the oral fluid screening and confirmatory tests' reliability. The review would examine two matters: the tests' reliability as stated in Commonwealth v. Lanigan, 419 Mass. 15 (1994) and the practical availability of an expert.[1] Lanigan testing presents alternative pathways. One pathway requires general acceptance of the tests by a relevant community of scientists.[2] The second pathway requires a showing of the tests' reliability. The second test employs as factors peer reviewed studies, error rates and other factors such as adoption of the testing by courts, legislatures and other organizations. A preliminary review of studies on the tests' reliability[3] provides a basis to believe that the tests may pass through the second pathway of reliability testing.[4]
2. The examination of the reliability test by Committee members would involve:
    i. (1) identifying criteria governing the studies aggregate satisfaction of scientific testing;
    ii. (2) conducting a literature review to identify important relevant studies; and
    iii. (3) applying the criteria to the culled studies.
3. The second matter concerns the practical availability of an expert to testify about the fluid sampling procedures and outcomes. This witness must be sufficiently familiar with the scientific basis for the capacity of the collective tests to reliably detect acute cannabis ingestion. Given the discretion involved in approving an expert's qualifications, a drug recognition expert with supplementary education about the fluid tests scientific underpinnings would likely qualify as an expert.

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[1] *See* Commonwealth v. Sands, 424 Mass. 184, 188-189 (1997)

[2] The community of scientists composes those who practice in the field who need to keep abreast of theories or techniques' reliability. See Commonwealth v. Patterson, 445 Mass 626, 641-642 (2012) Though the community need not contain academics it must include a broad sample of technicians and scientists so that the possibility of disagreement exists. Id.at 643

[3] *See* Field Detection of Drugs of Abuse in Oral Fluid, Journal of Analytical Toxicology, 2017, 1; Correlation between Blood and Oral Fluid Pyshoactive Drug Concentrations…, Current Neuropharmacology, 2017, 15, 1-12; Oral Fluid Reliability, J. Pharm, Pharm, Sci. 19(3), 411-422,(2016)

[4] Demonstrating satisfaction of the general acceptance pathway could be complicated and protracted. It would require identification of a relevant community combined with a showing that the community had positively reviewed the tests reliability. *See* Commonwealth v. Torres, 442 Mass. 554, 581 (2004) (general acceptance fails to require unanimity).

IIA- Contingent Recommendation

This contingent recommendation applies where internal testing by Committee members fails to find the studies satisfy Lanigan. In that instance, I propose that the Committee recommend that the Legislature appropriate modest funding for further research.

IIB- Contingent Recommendation

Conversely, where the Committee's internal review demonstrates good cause to believe that the oral fluid tests will pass Lanigan testing.[5] I recommend complementary legislative proposals. The proposals would be two-fold:

The first would be enactment of implied consent to oral fluid testing with loss of license as the incentive to compliance.[6] The second would be amendment of G.L. c. 276, § 2B to permit transmission by electronic means of a sworn affidavit in support of warrant authorizing collection of the oral fluid sample.[7] The electronic transmission would record the antecedent swearing of the oath.

The warrant amendment could refer to adoption of a Rule of Criminal Procedure addressing the electronic transmission of the sworn affidavit, documentation of the oath and transmission of the search warrant.[8] Procedure could serve as a continuing means for addressing practical problems.

The legislation on consent to collection of the oral fluid should be accompanied by a legislative history describing the screening and confirmatory test's collective reliability in detecting acute marijuana ingestion.[9]

Prior to amendment of G.L. c. 276, § 2B, the Committee could ask the Office of the Trial Court to issue of a protocol on the availability of magistrates and on-call judges to act on search warrant applications Protocols emphasize attention to a particular procedure and clarify how the

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[5] A brief review suggests support for the reliability finding. See Field Detection of Drugs of Abuse in Oral Fluid, Journal of Analytical Toxicology, 2017, 1; Correlation between Blood and Oral Fluid Pyshoactive Drug Concentrations…, Current Neuropharmacology, 2017, 15, 1-12; Oral Fluid Reliability, J. Pharm, Pharm, Sci. 19(3), 411-422, 2016.

[6] *See* G.L. c. 90, § 24.

[7] Current law demands an exceptional showing of need before utilizing a procedure where the affiant takes the oath outside the judge's presence. *See* Commonwealth v. Nelson, 460 Mass 564 (2011).

[8] *See* Generally Paul D. Beechen, *Oral Search Warrants a New Standard of Warrant Availability*, 21 UCLA L. Review 691 (1973) A Rule of Criminal.

[9] Mindful that the taking of oral fluid samples involve less intrusion than the taking of blood and acknowledging the substantial increases in motor vehicle collisions involving drivers impaired by the ingestion of drugs, it may be appropriate to ask for reconsideration of the ruling made in Birchfield v. North Dakota, 136 S. CT. 2160 (2016).

procedure will operate.[10] The protocol can become a component of Trial Court educational programs.

The protocol would inform magistrates and judges of how the warrant application process would operate after courts close. The protocol would focus on police officers access to a timely and accurate roster of available magistrates and on-call judges. It would contain land-line or cell phone numbers for each magistrate and on call judge. Each police department would be sent a copy of the appropriate roster. The State Police would assign an officer to serve as the person to call when available magistrates and on-call judges could not be reached.

Police departments would be expected to identify and explain the protocol.

B. Recommendations by the Massachusetts Chiefs of Police Association (Chief Carmichael)

Open Container:

The adult use marijuana law prohibits possession of an "open container" of marijuana in the passenger area of a motor vehicle while the vehicle is on a public way, whether or not the car is moving at the time. Violators may be subject to a civil penalty of not more than $500.[11]

Recommendation:

Massachusetts should require violations of Open Container of Marijuana in a motor vehicle under MGL Ch. 94G § 13(d) to be enforced in the same manner as alcohol under MGL Ch. 90 § 24I, possession of alcoholic beverages in motor vehicles. Currently open container of marijuana in a motor vehicle under MGL Ch. 94G § 13(g) is enforced by utilizing the non-criminal disposition procedures provided in section 32N of chapter 94C of the General Laws, which follows the procedures under section 21D.[12] Open container of marijuana in a motor vehicle should be deemed a motor vehicle offense. Issuance of citations and enforcement of such violations should fall under the provisions of the 90C offense procedure, not 21D.

Operating Under the Influence

The adult-use marijuana law M.G.L. c. 94G, § 2(a), makes no change in the longstanding criminal prohibition against operating a motor vehicle under the influence of marijuana.

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[10] *See*, *e.g.* New Protocol for PRE-Arraignment Emergency Psychiatric Hospitalization.
[11] *See* M.G.L. c. 94G, § 13(d).
[12] Notes – Section 21D: Fines shall be recovered by indictment or on complaint before a district court, or by noncriminal disposition in accordance with section twenty-one D.
Section 21D: Is for noncriminal disposition of ordinance, by-law, rule or regulation violations.
Under 21D: Fines cannot exceed $300 fine. The procedure shall not be used for the enforcement of municipal traffic rules and regulations.
Chapter ninety C shall be the exclusive method of enforcement of municipal traffic rules and regulations.

Operating under the influence of marijuana remains a criminal offense pursuant to terms of M.G.L. c. 90, § 24(1)(a)(1); however, because of issues with field sobriety testing (roadside assessments) following the Gerhardt decision, officers are limited in how they perform assessments at roadside and later testify in court. Officers specially trained to conduct field sobriety testing for drugs under Advanced Roadside Impaired Driving Enforcement (**ARIDE**), also have difficulty in testifying in court as the problem with lack of scientific evidence in establishing drug impairment from field sobriety testing remains unresolved. The purpose of ARIDE is to assist officers in determining if a Drug Recognition Expert (**DRE**) is required for further assessment. ARIDE is a prerequisite for the DRE training and some officers are fully trained in DRE, while others are trained solely in ARIDE.

While DRE's provide valid assessments in determining impairment and identifying specific categories of drugs the operator is under the influence of, there remain barriers with this process. These obstacles include the lack of an adequate amount of certified DRE's in Massachusetts, the extended time for a DRE to respond and complete the assessment, and collect evidence, which is typically 2 – 2 ½ hours, no implied consent or consequence for refusing a DRE, and admissibility of evidence & testimony in court under Daubert-Lanigan.

Recommendations:

1. Consensus: OUI Commission should accept research and studies, which support the fact that THC can cause impairment in motorists. THC impairs motor function, reaction time, tracking, cognitive attention, decision-making, impulse control, memory.
2. Funding: Massachusetts should fund training for police officers in legal update, ARIDE, DRE, Oral Fluid, or other accepted roadside presumptive tests. Efforts to ensure funding through the Massachusetts Marijuana Regulatory Fund are essential. See funding section in this document.
3. ARIDE: Train ALL Massachusetts police officers in ARIDE, including recruits in the academies. Massachusetts should study the validity of standardized field sobriety testing. Massachusetts should also study the correlation between marijuana and impairment detection using assessments such as the modified Romberg and lack of convergence assessment. The CCC research demonstrates efficacy in assessments, which are indicative of THC consumption & impairment, and should be accepted as valid measures of THC use as in the ARIDE Manual - National Highway Traffic Safety Administration.
    a. Examples:
        i. Modified Romberg – Head tilt, eyes closed, estimate 30 seconds – internal clock. (Eye lid tremors) (Touch Nose)
        ii. Lack of Convergence – THC causes eyes not to converge.

iii. Lack of Smooth Pursuit – Eyes WILL have smooth pursuit. Nystagmus not present at maximum deviation. No angle of onset or vertical nystagmus.
iv. Pupils – Dilated.

4. Horizontal Gaze Nystagmus: Officers should be permitted to testify to nystagmus tests. Massachusetts should look at states such as Maine, where officers routinely testify to nystagmus in OUI drug cases and study HGN validity.
5. DRE: Train more police officers in DRE. Consistent with other states, Massachusetts should train upwards of 300 drug recognition experts. See training process in this document.
6. Implied Consent: Require Implied Consent for DRE: Massachusetts should apply implied consent to DRE assessments as we currently do for breath & blood testing. Police should not be forced to file immediate threat for OUI drugs under MGL Ch. 90 § 22. Impose the same requirements and sanctions for drug testing that currently apply to alcohol testing. Test for breath, blood, urine (implied consent).
   a. Commentary by Attorney John Scheft: Support legislation to suspend drivers' licenses for failure to participate in blood, breath, or DRE tests. House Bill No. 3038, An Act Relative to Drug Driving, was proposed by Norfolk District Attorney Michael Morrissey. It seeks to replace G.L. c. 90, § 24 (f)(1), the portion of the OUI statute that concerns the suspension of a person's license for refusing to submit to a breath or blood test following a suspected OUI.
7. Tandem Per Se[13]: Massachusetts should adopt tandem per se procedures for when the sequence of events includes the officer's observations in addition to the operator having an amount of impairing substance in their system. Massachusetts should support administrative license revocation for positive roadside drug tests and/or refusal to provide a biological sample for evidential testing.
8. Oral Fluid Testing/THC Breath Test: Massachusetts should adopt the application of oral fluid testing as part of tandem per se. The Office of Alcohol Testing would perform the selection process of the devices and the MPTC would be responsive to requests for training related to fluid testing processes and devices.[14] As an example,

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[13] Tandem Per Se: A driver is guilty of OUI Drugs per se if the following sequence of events occurs:
a) An officer had probable cause, based on the driver's demeanor, behavior and observable impairment to believe that the driver was impaired; and
b) Proof that the driver had any amount of an impairing substance in their blood, oral fluid or breath. *Commonwealth vs. Thomas J. Gerhardt*.

[14] The tandem per se procedure is consistent with the SJC's comments in the Gerhardt decision in that;
The absence of scientific consensus regarding the use of standard FSTs in attempting to evaluate marijuana intoxication does not mean that they have no probative value. A police officer makes numerous relevant observations in the course of an encounter with a possibly impaired driver. There is no doubt that an officer may testify to his or her observations of, for example, any erratic driving or moving violations that led to the initial stop; the driver's appearance and demeanor; the odor of fresh or burnt marijuana; and the driver's behavior on exiting the vehicle.

oral fluid testing devices such as Drager DT5000[15], Drug Wipe5, Alere DDS2 have been shown to provide adequate sensitivity, specificity, accuracy, positive predictive value & negative predictive value. Oral fluid testing identifies drugged drivers proximate to the traffic stop and reduces the chance of diminished results, which may be delayed through DRE, & blood, urine tests hours later. As an alternative to tandem per se, oral fluid testing could be used in same manner as a portable breath test device. Offer the oral fluid test at roadside once probable cause is established and in the event of a positive test, use as a preliminary drug test prior to a DRE.

   a. Note: A judge in the state of California recently accepted a novel biologic marijuana test, the Draeger500 marijuana saliva test, to a Frye/Kelly courtroom standard. This allows for the first time, the admission of a marijuana saliva test as evidence in a courtroom in the United States. This sets precedent to facilitate the introduction of the saliva test as evidence in other courtrooms across the country (Draeger Courtroom 2016).

9. Preliminary Testing: Any operator who fails a preliminary drug test should be required to submit to evidentiary drug testing.
10. Crash Testing: Massachusetts should have mandatory admissible drug testing in ALL crashes resulting in death or serious bodily injury.
11. Poly-Drug Penalties: Being under the influence of multiple drugs increases the risk of crash. Massachusetts should adopt enhanced/increased penalties for Poly-Drug Use, including alcohol & marijuana use.
12. BAC Limit: Massachusetts should eliminate statutory presumption of innocence of .05% BAC, when other psychotropic drugs are also present.
13. Warrants: Massachusetts should implement electronic warrants to reduce delays in taking blood samples.
14. Phlebotomists: Offer training.

C. Recommendations by the Executive Office of Public Safety and Security (Undersecretary Jennifer Queally, Chief Legal Counsel David Solet)

1. Adopt California-style "Alcohol or Any Substance" Definition of OUI

- Current Massachusetts law, G.L. c. 90, § 24, requires proof that the defendant drove under the influence of (1) an alcoholic beverage; (2) marijuana; (3) a narcotic drug; (4) a stimulant or depressant as defined under G.L. c. 94C, § 1; or (5) the toxic fumes of any substance as defined in G.L. c. 270, § 18.

[15] Drager Drug Test 5000 consists of a Salvia Swab, covers seven types of drugs, has an eight-minute turnover time, and a cost of $4,500 plus $20 per cassette.

- In OUI-Drugs cases, the Commonwealth is required to prove beyond a reasonable doubt not just that the defendant operated while impaired by a substance, but the *category* of the substance causing impairment. This unnecessary requirement is detrimental to public safety.[16]
- This system is nonsensical. New drugs of abuse are constantly emerging on the illicit market. Many individuals use multiple drugs at once, making it difficult to conclusively attribute impairment to a particular substance. And all impaired drivers are a danger to themselves and others.
- Instead, Massachusetts should adopt the statutory formulation of California and simply require proof that the motorist was operating "under the influence of any drug."[17]
- New Hampshire follows a similar approach, prohibiting operation while under the influence of alcohol or "any controlled drug, prescription drug, over-the-counter drug, or any other chemical substance, natural or synthetic, which impairs a person's ability to drive."[18]

2. Adopt Statute Allowing Drug Recognition Experts to Testify as Expert Witnesses

- One of the most reliable methods of recognizing intoxication by drugs is through the examination of an impaired subject by a trained Drug Recognition Expert (**DRE**). Certified DREs are trained to apply a rigorous, standardized, 12-step screening protocol that has been funded by the National Highway Safety Administration (**NHTSA**), and are required to successfully evaluate live subjects who have ingested known types and quantities of drugs.
- The full 12-step DRE protocol consists of
  - 1) Breath Alcohol Test;
  - 2) Interview of Arresting Officer;
  - 3) Preliminary Examination and First Pulse;
  - 4) Eye Examination, including Horizontal Gaze Nystagmus (HGN);

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[16] *See*, *e.g.*, Commonwealth v. Ferola*,* 72 Mass. App. Ct. 170 (2008) (though profoundly impaired defendant admitted to taking Klonopin to officer and nurses, conviction reversed because Commonwealth failed to prove that Klonopin was a "depressant" defined by G.L. c. 94C, § 1); Commonwealth v. Finegan*,* 45 Mass. App. Ct. 921 (1998) (though defendant motorist obviously under the influence of heroin, conviction reversed because Commonwealth failed to classify the drug under the categories of the statute); Commonwealth v. Green, 408 Mass. 48*,* 49 (1990) (OUI-Drugs conviction reversed where Commonwealth failed to prove that codeine was a "narcotic drug" as defined in G.L. c. 94C, § 1).
[17] Cal. Vehicle Code § 23152(f).
[18] NH Rev State § 265-A:2.

- 5) Divided Attention Psychophysical Tests;
- 6) Vital Signs and Second Pulse;
- 7) Dark Room Examinations;
- 8) Examination for Muscle Tone;
- 9) Check for Injection Sites and Third Pulse;
- 10) Subject's Statements and Other Observations;
- 11) Analysis and Opinions of Evaluator;
- 12) Toxicological Examination.

- Studies have shown that a properly trained DRE can consistently identify drug impairment in a human subject.[19]
- Massachusetts currently has approximately 150 officers certified as DREs statewide.
- However, many Massachusetts trial courts have refused to let DREs testify in an expert capacity, reasoning that their identification of symptoms amounts to a medical diagnosis, and questioning whether the DRE protocol has sufficient acceptance in the relevant scientific community.[20]
- Massachusetts would benefit from a statute that specifically authorized properly certified DREs to offer their expert opinions, including (as any other expert would) in situations in which the expert was not a percipient witness, but was called to offer interpretative context to observations made at the crime scene by another witness.
- Maine has such a statute. *See* 29-A M.R.S.A. § 2525, which specifically makes DRE testimony admissible in court,[21] and § 2526, which sets forth the eligibility,

[19] *See*, *e.g.*, R. Compton, "Field Evaluation of the Los Angeles Police Department Drug Detection Program," U.S. D.O.T. H.S. 807 012 (Feb. 1986); G. Bigelow,W. Bickel, J. Roache, I Liebson and W. Nowowieski, "Identifying Types of Drug Intoxication: A Laboratory Evaluation of a Subjection-Examination Procedure," U.S. D.O.T. H.S. 806 753 (May 1985).

[20] *See*, *e.g.*, Commonwealth v. Lincoln, 89 Mass.App.Ct. 1120, 2016 WL 1728966 (2016) (DRE barred from testifying in expert capacity); Commonwealth v. Lapix, Woburn District Court, 1053-CR-2181 (barring DRE who examined suspect from testifying to "the three steps of the protocol [HGN test, evaluation of suspect's nasal and oral cavity, and evaluation of suspect's muscle tone] that have scientific aspects"); Commonwealth v. Gluck, Woburn District Court, 1153-CR-0403 (barring DRE from offering expert opinion based on analysis of observations made by arresting officer).

[21] 29-A M.R.S.A. § 2525 reads as follows:

> 2. Admissibility of evidence. If a law enforcement officer certified as a drug recognition expert by the Maine Criminal Justice Academy conducts a drug impairment assessment, the officer's

training, and certification requirements for "drug recognition technicians" in that state.

3. **Adopt Statute Making Properly-Administered HGN Test Admissible**

   - The Horizontal Gaze Nystagmus test is one of three field sobriety tests that comprise the Standardized Field Sobriety Test (**SFST**) battery approved by the NHTSA, along with the "walk-and-turn" test and the "one-leg-stand" test. The HGN test is widely recognized as the single most predictive element of the Standardized Field Sobriety tests,[22] and its use by trained police officers has been recognized as a "scientifically valid and reliable tool" by the American Optometric Association.[23] "Nystagmus" is the involuntary jerking of the eye that occurs when a subject is impaired by alcohol, inhalants, phencyclidine (**PCP**), or central nervous system depressants like diazepam (sold under the name-brand Valium) or alprazolam (sold under the name-brand Xanax).[24] Studies have revealed a direct linear relationship between blood alcohol concentration (**BAC**) and the point where nystagmus starts (referred to as the angle of onset of nystagmus): a person's BAC may be estimated by subtracting the angle of onset from 50.[25] The HGN test is also part of the DRE protocol described above. HGN is not just an indicator of impairment; HGN *is* impairment.[26] Nystagmus impairs the eye's ability to track a moving object. Thus, drivers with pronounced

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> testimony about that assessment is admissible in court as evidence of operating under the influence of intoxicants. Test results showing a confirmed positive drug or metabolite in the blood or urine are admissible as evidence of operating under the influence of intoxicants. Failure to comply with any provision of this section does not, by itself, result in the exclusion of evidence of test results, unless the evidence is determined to be not sufficiently reliable."

See http://legislature.maine.gov/statutes/29-A/title29-Asec2525.html

[22] *See* "Horizontal Gaze Nystagmus: The Science & The Law, A Resource Guide for Judges, Prosecutors and Law Enforcement," National Highway Traffic Safety Administration, *available a*t http://www.nhtsa.gov/people/injury/enforce/nystagmus/hgntxt.html, noting that HGN is "the most reliable field sobriety test" and "the most effective roadside weapon against alcohol-impaired driving."

[23] *See* American Optometric Association, HOD Resolution 1901, "Horizontal Gaze Nystagmus as a Field Sobriety Test," adopted June 18, 2011.

[24] *See* J. Stapleton, S. Guthrie, and M. Linnoila, "Effects of Alcohol and Other Psychotropic Drugs on Eye Movements: Relevance to Traffic Safety," 47 J. STUD.ALC. 426 (Sep. 1986); C. Rashbass, "The Relationship Between Saccadic and Smooth Tracking Eye Movements," 159 J. PHYSIOLOGY 326 (1961) (nystagmus is indicative of barbiturate use);

[25] *See* V. Tharp, Gaze Nystagmus as a Roadside Sobriety Test; T. Forrest, "The rapid eye test to detect drug abuse," 84 POSTGRADUATE MED. 108 (Jul. 1988). *See also* State v. Superior Court of the County of Cochise, 149 Ariz. 269, 718 P.2d 171, 180-181 (1986) ("the professionals who have investigated the subject do not dispute the strong correlation between BAC and the different types of nystagmus"); Williams v. State, 710 So. 2d 24 (Fla. 3d DCA 1998), rehearing denied, 725 So. 2d 1111 (Fla. 1998). The margin of error for the HGN test is approximately 0.02. Thus, a person with an angle of onset of 35 degrees should have a BAC of approximately .15 (or between .13-.17).

[26] *See* J. Stapleton, S. Guthrie, and M. Linnoila, Effects of Alcohol and Other Psychotropic Drugs on Eye Movements: Relevance to Traffic Safety, 47 J. STUD.ALC. 426 (Sep. 1986).

nystagmus have been proven to observe significantly fewer "traffic aspects" than drivers without nystagmus.[27]

- To administer the HGN test, an officer informs the subject, "I am now going to check your eyes," and then examines for the physical manifestations of intoxication. After some preliminary questions, the officer asks the subject to follow an object with his or her eyes, such as a pen or the tip of a penlight. The officer places the object approximately twelve to fifteen inches from the subject's face and slightly higher than eye level. The officer instructs the subject to follow the object with the eyes and the eyes only; the subject's head should remain still. The officer then asks if the subject understands all the instructions. After checking for signs of medical impairment, the officer looks for six "clues" (three in each eye) that indicate impairment from alcohol intoxication. The clues are:
  - Lack of Smooth Pursuit
  - Distinct Nystagmus at Maximum Deviation
  - Angle of Onset of Nystagmus Prior to Forty-Five Degrees
- In much of the country, the results of this test are being admitted against impaired drivers at trial.[28] However, despite its high degree of reliability and ease of administration, the HGN test is virtually never admitted at trial in Massachusetts courts. Massachusetts police officers are currently trained to use the HGN test, and routinely employ it in making roadside assessments to inform their arrest decisions. The test is admitted in pretrial proceedings when officers are required to articulate the basis for their probable cause decisions. But in 1997 the Supreme Judicial Court held that the HGN test was different from other field sobriety tests, because its probative nature is less obviously intuitive to jurors than tests that involve physical coordination. As a result, the SJC concluded that, "the HGN test relies on an underlying scientific proposition and therefore expert testimony is required."[29]

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[27] W. Buikhuisen and R.W. Jongman, Traffic Perception Under the Influence of Alcohol, 33 Q. J. STUD.ALC. 800 (Sep. 1972).

[28] The testimony of a trained police officer about his or her administration of the HGN test has been deemed admissible at trial to show impairment in 36 states and the District of Columbia (AK, AZ, AR, CT, DC, FL, GA, HI, ID, IL, IN, IA, KY, LA, ME, MI, MN, MO, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, SC, SD, TX, UT, WA, WV, WI, WY). In 8 states (CA, DE, MD, MT, PA, TN, WA, MA), expert testimony regarding the scientific underpinnings of nystagmus is required before HGN can be admitted. AL allows evidence of the HGN test for probable cause analysis only. KS and MS have found HGN not reliable, at least based upon the evidence submitted by the government in their cases. CO, RI, VT and VA appear not to have any published cases on the question. See National Traffic Law Center, at http://www.tsrp-idaho.org/resources/SFST/52_HGN_Chart_2015.pdf

[29] *See* Commonwealth v. Sands, 424 Mass. 184, 188 (1997).

- As a practical matter, the requirement that the Commonwealth produce an expert witness who can testify to the underlying scientific basis for nystagmus makes the HGN test inadmissible, as such witnesses (e.g., opthalmologists) are so rare and expensive that they are functionally unavailable to the Commonwealth. As a result, the holding of the Sands case has placed the Commonwealth at a severe disadvantage.

- A simple statute recognizing that the HGN test is effective and authorizing jurors to draw an inference of impairment would enhance public safety at virtually no cost to the Commonwealth. North Carolina enacted such a statute, N.C. Rule 702 (a1)(1), in 2006.

4. Adopt Statute Making Oral Fluid Testing Admissible

- In November, 2018, the Massachusetts State Police published the results of a study assessing their field testing of two commercially available portable testing technologies that allow rapid analysis of oral fluid (saliva) for the presence of drugs.

- The testing indicated that the one of the portable devices, the DDS-2, was highly accurate in detecting the presence of THC, cocaine, benzodiazepines, and opiates, with lower accuracy for amphetamines and methamphetamines; a second device, the DDT500, was highly accurate in detecting the presence of THC, cocaine, amphetamine, opiates and methadone, with lower accuracy for benzodiazepines.

- Nothing in existing law would bar an officer from requesting that a motorist provide an oral fluid sample on a purely consensual basis, in the same way that police employ the PBT (Portable Breath Test) device to test for alcohol intoxication. This would provide an avenue for a suspect to exonerate himself during a roadside encounter if an officer was concerned that he was impaired by drugs. If a motorist declined to cooperate, the officer would be required to conduct a probable cause analysis based on the evidence available to him, and either release the motorist, or place him under arrest.

- A statutory amendment could create an implied consent requirement for oral fluid testing for those arrested upon a finding of probable cause for OUI, just as current law contains an implied consent for breath or blood testing. Subjects would provide an initial oral fluid sample for presumptive analysis that would be immediately available to police (to assist in accurate charging), and would provide a second sample for confirmatory analysis in a laboratory environment.

- In order to make the results of such testing available at trial through the testimony of an arresting officer, a statutory amendment should be drafted, similar to existing law regarding infra-red breath testing instruments, that would allow the admission of results obtained through oral fluid testing instruments that a) conform to state regulations and b) are properly maintained and calibrated.

- In order for confirmatory results to be admitted at trial, a chemist who performed the confirmatory analysis in a laboratory environment would be required to appear to testify and be subjected to cross-examination, as they do for testing of drugs.[30]

5. Facilitate Use of Judicially Authorized Search Warrants to Efficiently and Humanely Acquire Blood Samples to Test for Drugs and Alcohol

- There is no constitutional bar to the seizure of blood from a criminal defendant where the Commonwealth has obtained a search warrant supported by probable cause.[31] A grand jury may petition a court for the taking of a suspect's blood.[32]
- However, the current iteration of the Massachusetts OUI law contains statutory bars that prohibit admission of blood test evidence in an OUI prosecution if it was not obtained "with the consent of the defendant."[33]
- Given the "lack of objection" standard set out by Carson, the current statute appears to prohibit the use of search warrants to obtain blood evidence from a reluctant OUI defendant. If the statutory bar was removed, search warrants could be used as they are in all other contexts: to compel grudging compliance or, if the defendant is physically non-compliant, to allow the admission of refusal evidence or the application of criminal contempt penalties. A suspect's refusal to comply with a lawful court order is admissible at trial, even under Article 12, *see* Commonwealth v. Delaney, 442 Mass. 604, 607-608 (2004) ("We conclude that there was no error, as evidence of a defendant's resistance to a warrant or court order may be introduced without violating art. 12"), and the U.S. Supreme Court has made explicit that, because there is no right to resist the execution of a lawful warrant, states may elect to criminalize refusal to comply with a search warrant. Birchfield v. North Dakota, 136 S.Ct. 2160, 2172 (2016).

[30] *See* Melendez-Diaz v. Massachusetts, 557 U.S. 305 (2009) (Commonwealth's statute providing for self-authenticating certificate of drug analysis violates Confrontation Clause of U.S. Constitution).
[31] *See* Commonwealth v. Davidson, 27 Mass.App.Ct. 846, 848 (1989).
[32] *See* Commonwealth v. Powell, 450 Mass. 229, 237 (2007).
[33] *See* G.L. c. 90, § 24(1)(e) and G.L. c. 90, § 24(1)(f)(1); Commonwealth v. Carson, 72 Mass.App.Ct. 368, 370 (2008) ("Nevertheless, the applicable statute, G.L. c. 90, § 24(1)(e) and (f), requires a defendant's actual consent to breath and blood testing as a condition of admissibility of the results in evidence. The consent required is not the 'knowing, voluntary and intelligent' consent required for waiver of constitutional rights, but the consent of customary usage indicated by criteria such as verbal agreement to undergo, lack of objection to, or cooperation in the performance of, the blood testing").

- In order to facilitate the production of search warrants before the evidence of impairment is lost, the Commonwealth should allow search warrant applications to be transmitted electronically. As Chief Justice Roberts observed in Missouri v. McNeely, 569 U.S. 141, 172 (2013) (requiring search warrants for OUI blood tests in the absence of exigency),

  > police can often request warrants rather quickly these days. At least 30 States provide for electronic warrant applications. . . in one county in Kansas, police officers can e-mail warrant requests to judges' iPads; judges have signed such warrants and e-mailed them back to officers in less than 15 minutes.

  But these advances have not taken place in Massachusetts. Facilitating quick turnaround between the drafting of a probable cause affidavit and approval of a warrant application is particularly critical in OUI cases, where the suspect's body will be actively metabolizing the sought-after evidence while police await approval to search.

6. Adopt Legislation Imposing Administrative License Suspension for Noncompliance with Oral Fluid Testing and DRE Examination

- In most states, evidence of a defendant's non-compliance with field sobriety testing and breath test refusal is admissible as consciousness of guilt evidence against a defendant at trial. However, Article 12 of the Massachusetts Declaration of Rights has been interpreted to prohibit the admission of such refusal evidence in a criminal proceeding.[34] Reversal of this principle would require a state constitutional amendment.

- But Article 12 does not prevent *administrative* sanctions, such as license suspension, for non-cooperation with sobriety testing, and Massachusetts has imposed such sanctions for arrested parties who refuse to comply with breath testing.[35] Administrative sanctions for non-compliance with breath testing has two positive effects: it helps take dangerous motorists off the road, at least temporarily, through license suspension; and it provides an incentive for arrested suspects to assent to breath testing.

- The SJC has opined in the past that it would be lawful for the Commonwealth to expand its administrative sanctions regime for non-compliant motorists.[36] To this

[34] *See*, *e.g.* Opinion of the Justices to the Senate, 412 Mass. 1201 (1992).
[35] *See* G.L. c. 90, § 24(1)(f)(1); Commonwealth v. Luk, 431 Mass. 415, 423 (1995) (upholding administrative license suspension for breath test refusal as non-punitive).
[36] *See* Commonwealth v. Blais, 428 Mass. 294, 301 at n.6 (1998) ("Although the Legislature has made no similar provision for suspension upon refusal to perform road-side sobriety tests, *we have no doubt that it might*.") (emphasis added).

point, however, the legislature has never expanded administrative sanctions beyond non-compliance with breath testing. A statute could impose a requirement that a person who has been arrested for OUI-Drugs assent to other forms of sobriety testing (such as traditional field tests, submission of blood or urine for chemical analysis, or some combination of these) or face administrative sanctions. The right not to have refusal evidence admitted at trial does not constitute a right to refuse testing.[37] In Birchfield v. North Dakota, 136 S.Ct. 2160, 2185 (2016), the U.S. Supreme Court specifically held that while motorists who refuse to consent to blood tests may not face criminal penalties for refusal, there is no constitutional bar to civil or administrative penalties (such as license suspension).

7. Make Explicit that Drug Concentration Evidence is not a Precondition to Admission of Evidence of the Presence of an Impairing Substance

- In 2005, the Appeals Court reversed a conviction in the case of Commonwealth v. Shellenberger, 64 Mass. App. Ct. 70, 76 (2005). In that case, the defendant was charged with misdemeanor motor vehicle homicide, and not with operating under the influence. But intoxication took center stage at the trial, when the prosecution elicited from a pathologist that the defendant's medical records (admitted to show the defendant's injuries) also revealed the presence of amphetamines in her urine. Perhaps because the Commonwealth's initial theory of liability had been centered on excessive speed, and not on intoxication, the Appeals Court concluded that this evidence was admitted "unfairly," and seized particularly on the fact that the medical records admitted were silent as to the *concentration* of amphetamines in the defendant's system.

- In an illustration of the maxim that "hard cases make bad law," the Appeals Court held that,

> There was no foundation to support the theory that the amphetamine use was the cause of the accident. To be properly admitted, the evidence of amphetamines in the defendant's system in this case required, at a minimum, 1) reliable evidence as to the amount or concentration of the drug in the defendant's system; and 2) expert testimony indicating that the concentration of the drug in the defendant's system would impair her ability to operate a motor vehicle.[38]

[37] *See* Commonwealth v. Davidson, 27 Mass.App.Ct. 846, 848 (1989) ("[w]here there is probable cause to believe that a defendant has been operating a vehicle while under the influence of intoxicating liquor, *the defendant has no constitutional right to refuse a blood test or a breathalyzer test*") (emphasis added).
[38] *Id*. at 76.

- This principle – that evidence of the presence of a drug in the defendant's system requires evidence of the concentration of the drug *as a precondition to admissibility* – is in tension both with longstanding state practice in OUI-alcohol cases and with common sense. In practice, adherence to the Shellenberger requirement would cause enormous practical difficulty for the Commonwealth, as in the absence of a blood test, evidence of drug *concentration* is almost uniformly unavailable to the Commonwealth, even if the defendant admits consuming the substance, and evidence of impairment is substantial.
- Several unpublished opinions have since rejected the requirements laid out by the Shellenberger court.[39]
- But while these unpublished cases have ignored Shellenberger, they have not overruled it. The troubling holding of Shellenberger should be reversed with a simple addition to the OUI statute clarifying that the absence of concentration evidence in an OUI case goes to the weight of the evidence, and not to its admissibility.

8. Eliminate Public Way Requirement

- It is unnecessary for due process and antithetical to public safety to require that to commit an OUI offense, the motor vehicle must be operated on "a public way." Some of the most dangerous impaired operation occurs on non-public ways – e.g., in private driveways, gated communities, on fields, in campsites, etc.
- The tortured litigation history of public way under G.L. c. 90, § 24 attests to the unnecessary inclusion of this element.[40]

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[39] *See* Commonwealth v. Smola, 69 Mass.App.Ct. 1113 (2007), 2007 WL 2163991 (where Commonwealth presented evidence of reckless driving, presence of marijuana in the defendant's vehicle, and symptoms of marijuana consumption, evidence of drug concentration and expert testimony not necessary to support OUI-Drugs conviction); Commonwealth v. Poto, 87 Mass.App.Ct. 1117 (2015), 2015 WL 2035627 (though no evidence of drug concentration was admitted at trial, no substantial risk of miscarriage of justice where defendant admitted that he consumed marijuana and Vicodin, and there was "extremely robust" evidence of his significant actual impairment); Commonwealth v. Reed, 89 Mass.App.Ct. 1128 (2016), 2016 WL 3344314 at n. 2 (evidence of defendant's abrupt stop, bloodshot eyes, strong smell of marijuana, and statement that he was "high" was sufficient to support OUI-Drugs conviction, despite absence of evidence of concentration of marijuana in defendant's system).

[40] *See* Commonwealth v. George*,* 406 Mass. 635 (1990) (defendant flipped his vehicle on the pitcher's mound of a little league field; SJC felt compelled to overturn his conviction since the field was not an area of access to the "motoring public"; court notes irony that if defendant had overturned his vehicle in the parking lot next to the field, he would have been guilty); Commonwealth v. Stoddard*,* 72 Mass. App. Ct. 179 (2009) (Appeals Court overturns conviction of profoundly impaired defendant who was driving his car on dirt roads in an occupied campground with people in tents; court felt that a secure gate, which separated the campground from a public street, made this an area where there was no access to the public, only approved campers and their guests; court warned that its decision could endanger other gated

D. Recommendations by the American Civil Liberties Union – Massachusetts (Matthew Allen)

Statement of Principles:

The ACLU recognizes that operating a motor vehicle while impaired by any substance presents a serious public safety hazard that warrants policy responses to protect the public. The ACLU recommendations are based around these three principles:

1. Science: Any policies meant to address cannabis OUI should be based in evidence and supported by fact.
2. Liberty: Any recommendations should be examined in the greater context of criminal legal reform, and must include consideration of due process and other civil liberties concerns. The ACLU is opposed to policies that would roll back the progress cannabis legalization has achieved in reducing criminal legal system involvement of cannabis consumers.
3. Equity: The racial justice implications of any policy recommendations must be examined given the historic racial bias in enforcement of cannabis laws in Massachusetts.

Policy Recommendations:

1. At the present time, the ACLU is opposed to creating a "per se" limit of THC in the blood that would constitute impairment under the law because there is no evidence that a specific level of THC in the blood is correlated to impairment for everyone or most individuals. Furthermore, there is evidence that such a policy would disproportionately and unfairly impact medical cannabis patients.
2. The ACLU is not opposed to creating a "per se" limit of THC in the blood or in oral fluid if and when scientific tests establish a correlation between levels of THC and impairment with similar accuracy and specificity to the breathalyzer used for alcohol.
3. The ACLU is opposed to an "implied consent" law that would suspend the licenses of motorists who refuse to give blood, oral fluid, or submit to a Drug Recognition Expert (DRE) exam until such a time that scientific evidence has

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community occupants at educational institutions and living communities, and suggested the legislature consider changing the statute); Commonwealth v. Smithson, 41 Mass. App. Ct. 545 (1996) (defendant driving recklessly in a gravel pit while highly intoxicated; passenger killed when thrown from the vehicle; but because facility's gate was not open at the time, there was no proof of public way, and defendant's OUI and motor vehicle homicide convictions overturned).

successfully demonstrated that these tests effectively and accurately measure impairment.

4. The ACLU emphasizes that blood tests of motorists should never be permitted unless law enforcement agents have obtained a warrant.
5. The ACLU recognizes that the lack of scientific evidence validating DRE exams is a barrier to admitting results in court, and recommends that the state fund scientifically valid studies to determine how and whether DRE test results correlate to the recent use of various drugs and actual impairment as a result.
6. The ACLU recommends that the legislature require all law enforcement agencies to collect and share with the public data on motor vehicle stops, including the race, age, and gender of the motorists and the result of the stop.
7. The ACLU is opposed to creating any new criminal penalties related to cannabis use, such as increasing the "open container" penalty for cannabis to make it a criminal offense.
8. The ACLU is opposed to suspending the licenses or creating new criminal penalties for motorists who cannot pay fines. License suspension due to nonpayment of fines disproportionately and negatively impacts low income individuals in rural areas who need to drive in order to work, transport family members to medical appointments, and complete other life activities. If the legislature institutes a policy that includes license suspension for nonpayment of fines, reduced fees or payment plans should be made available to low income individuals.
9. The ACLU is not opposed to increasing funding for training and validation (or invalidation) of the accuracy of Drug Recognition Experts in Massachusetts. If and when the DRE exam is scientifically validated, the ACLU would support training to ensure that DREs are following evidence-based protocols.
10. At such time as blood or saliva tests are developed to effectively and accurately measure impairment, the ACLU is not opposed to establishing procedures that would allow law enforcement agents to expedite requests for warrants to draw blood or saliva from motorists suspected of operating under the influence.
11. The ACLU supports funding public service messages and other education programs to educate motorists about the risks of driving under the influence of cannabis and other drugs.

E. <u>Recommendations by AAA Northeast (Mary Maguire)</u>

    a. A requirement that the Commonwealth recruit and train an additional 100 Drug Recognition Experts to assist in identifying drug-impaired drivers on MA roadways.

b. A requirement that all law enforcement officers in the Commonwealth become ARIDE (Advanced Roadside Impaired Driving Enforcement) certified, with funding for this initiative derived from taxes generated through the sale of recreational marijuana.
c. A requirement that all Massachusetts marijuana dispensaries are to provide printed informational materials to customers with safety messaging focused on recreational marijuana and impaired driving. These materials are to be included inside bags of all product sold at the dispensaries. (AAA Northeast and the MA Highway Safety Division are currently preparing materials.)
d. A requirement that a marijuana/impaired driving module be added to the Massachusetts driver education curriculum.
e. A requirement that the commission recommend that funding be provided for a public awareness and education campaign outlining the dangers of driving under the influence. This campaign would include the Massachusetts Highway Safety Division, the Department of Public Health, and other traffic safety stakeholders.

F. <u>Recommendations by the Massachusetts Medical Society (Dr. Alan Ehrlich, MD FAAFP.)</u>

a. Funds should be allocated to support research into the following areas:
    i. Reliability of DRE for assessing cannabis use. Research needs to include individuals with demographic characteristics (age, race) to ensure its validity across the various populations in Massachusetts that might be affected.
    ii. Duration of impairment following cannabis consumption both inhaled and orally, and in intermittent users as well as chronic users. Again, appropriate demographic groups must be represented in the research populations
    iii. Until there is a reliable noninvasive method for assessing acute cannabis ingestion, funding should be made available to test new technologies as they are developed.
    iv. Additional funding for more DRE trained officers should be allocated but I would not recommend making DREs mandatory (or risk loss of license), until there is better data presented on the validity of the DRE evaluation.
b. At this time, no blood level or saliva test can be reliably used by itself as proof of impairment.

c. Educational public service announcement campaigns should be developed to promote awareness of the dangers of driving after cannabis use. Specific programs should be developed for incorporation into Driver's Ed.
d. Penalties for driving under the influence of cannabis should be comparable to penalties for driving under the influence of alcohol

G. Recommendation by Sabra Botch-Jones

[*For references, please see Appendix A.*]

Background

Δ-9-tetrahydrocannabinol (**THC**) is the most active of the principle constituents of marijuana. Δ-9-Carboxy-THC (**THC-COOH**) is a metabolite of the principle constituent of marijuana. Marijuana can be administered orally or by smoking in addition to other less common routes. Doses of 5-20 mg results in sedation, euphoria, hallucinations and temporal distortion. Following oral administration of THC, peak plasma levels average 6 ng/mL. After smoking a 15.8 mg dose of THC the peak plasma concentrations average 84 ng/mL and rapidly declines reaching an average of 1.2 ng/mL within approximately 3 hours. The elimination half-life average 33 hours in infrequent users of marijuana and 40 hours in frequent users. The maximum psychological effect persists for 4 to 8 hours but lags behind the time of peak THC plasma level by 10-30 minutes for smoking and by 1-3 hours for oral administration. In a study investigating the acute effects of smoking high-potency cannabis joints on psychomotor skills related to driving, researchers found that subjects still reported experiencing a "high" or "feelings of intoxication" well past peak levels, with measured concentrations dropping below 5 ng/mL. Research shows inter-individual variation in impairment, with some individuals being dangerously impaired at very low levels.

Determining exposure to marijuana through testing biological matrices is a key component in assessing impairment. The intrusiveness of these test varies. Historically, blood and/or urine samples were the most common specimens submitted for toxicological analysis. Various studies have been conducted to determine past versus acute exposure to cannabis through toxicological analysis. However, due to differences in study designs and inconsistencies in results between studies it is not advisable that a per-se level be established. This is further supported in position statements by other organizations tasked with assessing marijuana and driving impairment such as the National Safety Council's Alcohol, Drugs and Impairment Division.

The Drug Recognition Evaluation/Drug Evaluation and Classification Program (**DRE/DECP**) is an existing tool to assess impairment in suspected drugged driving cases. When used in combination with toxicological testing it provides greater insight on driver impairment.

The number of trained DREs in the Commonwealth could be expanded. With the legalization of marijuana, drugged driving cases may continue to increase and therefore the need for more trained DREs may be necessary. Toxicological analysis will help corroborate the results obtained from a DRE and should be conducted.

Biological fluids such as blood, plasma, and urine are useful in documenting exposure to cannabis, however scientific data supporting a per se level is inconsistent and therefore establishing a THC level alone is not recommended in assessing impairment. Further, less intrusive samples such as oral fluid may be used. As with urine, at this point it cannot be used to accurately measure or estimate the blood THC concentration. However, it does allow for a non-invasive sample that can be collected and tested in the field.

Further, the Massachusetts Oral Fluid Drug Testing Study was conducted by the Center for Forensic Science Research and Education on behalf of the Executive Office of Public Safety and Security and the Department of State Police. This study evaluated two commercially available oral fluid (saliva) field-based drug testing devices, the Alere Drug Detection System II (DDS-2, Abbott, IL, USA), and the Dräger Drug Test 5000 (DDT5000, Dräger, CO, USA). These systems were used to obtain a presumptive identification in the field. Additionally, a second oral fluid sample using the Quantisal® oral fluid collection device (Abbott, IL, USA) was collected and submitted to a reference laboratory for additional testing. Per the report "Overall the Alere DDS-2 performed well, with sensitivity, or ability to correctly identify drug positive drivers 86.4% of the time, specificity of 94.1%, reflecting the devices ability to correctly identify drug negative subjects. The overall accuracy of the device across drug positive and negative subjects was 92.5% which is consistent with prior reports of the performance of the instrument. The overall false positive rate for the DDS-2 was 4.7%, and the false negative rate was 2.8%." And further the study states "Overall the DDT5000 had lower sensitivity, or ability to correctly identify drug positive drivers of 64.6% (compared to 86.4% on the DDS-2), but specificity, reflecting the device's ability to correctly identify drug negative subjects was 99.1%, compared to 94.1% for the DDS-2. The overall accuracy of the DDT5000 across drug positive and negative subjects was 92.6% (compared to 92.5% for the DDS-2). The overall false positive rate in this study for the DDT5000 was 0.7%, and the false negative rate was 6.7%."

Regardless of the field-testing approach utilized, a laboratory based confirmatory test should take place to confirm presumptive findings. Analytical testing approaches will vary by laboratory, but could include gas chromatography-mass spectrometry, liquid chromatography-mass spectrometry, or other chromatographic and mass spectrometry approaches.

Appendix A: References

Recommendation from Sabra Botch-Jones - Scientific Testing and Data

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Special Commission on Operating Under the Influence

RECOMMENDATIONS

December 21, 2018

Oral Fluid Testing

Recommendations from Undersecretary Jennifer Queally, Chief Legal Counsel David Solet
Executive Office of Public Safety and Security

1. Adopt Statute Making Oral Fluid Testing Admissible (Recommendations, pg.11).

Recommendations by Dr. Alan Ehrlich, MD FAAFP., of the
Massachusetts Medical Society

2. At this time, no blood level or saliva test can be reliably used by itself as proof of impairment (Recommendations, pg.18).

Oral Fluid Testing

Recommendations from District Attorney Tom Quinn and Judge (Ret.) Robert Kane

Massachusetts District Attorney's Association

3. The initial recommendation proposes review by Committee members of the oral fluid screening and confirmatory tests' reliability. The review would examine two matters: the tests' reliability as stated in Commonwealth v. Lanigan, 419 Mass. 15 (1994) and the practical availability of an expert. Lanigan testing presents alternative pathways. One pathway requires general acceptance of the tests by a relevant community of scientists. The second pathway requires a showing of the tests' reliability. The second test employs as factors peer reviewed studies, error rates and other factors such as adoption of the testing by courts, legislatures and other organizations. A preliminary review of studies on the tests reliability provides a basis to believe that the tests may pass through the second pathway of reliability testing (Recommendations, pg.1).

Oral Fluid Testing

Recommendations from District Attorney Tom Quinn and Judge (Ret.) Robert Kane

Massachusetts District Attorney's Association

4. The examination of the reliability test by Committee members would involve:
   i. (1) identifying criteria governing the studies aggregate satisfaction of scientific testing;
   ii. (2) conducting a literature review to identify important relevant studies; and
   iii. (3) applying the criteria to the culled studies (Recommendations, pg.1).

Expert Witnesses

Recommendations from District Attorney Tom Quinn and Judge (Ret.) Robert Kane

Massachusetts District Attorney's Association

5. The second matter concerns the practical availability of an expert to testify about the fluid sampling procedures and outcomes. This witness must be sufficiently familiar with the scientific basis for the capacity of the collective tests to reliably detect acute cannabis ingestion. Given the discretion involved in approving an expert's qualifications, a drug recognition expert with supplementary education about the fluid tests scientific underpinnings would likely qualify as an expert (Recommendations, pg.1).

Recommendations from Undersecretary Jennifer Queally, Chief Legal Counsel David Solet

Executive Office of Public Safety and Security

6. Adopt Statute Allowing Drug Recognition Experts to Testify as Expert Witnesses (Recommendations, pg.7).

Penalties

Recommendations from Chief Carmichael
Massachusetts Chiefs of Police Association

7. Massachusetts should require violations of Open Container of Marijuana in a motor vehicle under MGL Ch. 94G § 13(d) to be enforced in the same manner as alcohol under MGL Ch. 90 § 24I, possession of alcoholic beverages in motor vehicles. Currently open container of marijuana in a motor vehicle under MGL Ch. 94G § 13(g) is enforced by utilizing the non-criminal disposition procedures provided in section 32N of chapter 94C of the General Laws, which follows the procedures under section 21D . Open container of marijuana in a motor vehicle (Recommendations, pg. 3).

Recommendations by Dr. Alan Ehrlich, MD FAAFP., of the
Massachusetts Medical Society

8. Penalties for driving under the influence of cannabis should be comparable to penalties for driving under the influence of alcohol (Recommendations, pg.19).

Penalties Cont.

Recommendations from Matthew Allen

American Civil Liberties Union – Massachusetts

9. The ACLU is opposed to creating any new criminal penalties related to cannabis use, such as increasing the "open container" penalty for cannabis to make it a criminal offense (Recommendations, pg.17).

Funding & Training

Recommendations from Chief Carmichael
Massachusetts Chiefs of Police Association

10. Funding: Massachusetts should fund training for police officers in legal update, ARIDE, DRE, Oral Fluid, or other accepted roadside presumptive tests. Efforts to ensure funding through the Massachusetts Marijuana Regulatory Fund are essential. See funding section in this document (Recommendations, pg.4).

11. DRE: Train more police officers in DRE. Consistent with other states, Massachusetts should train upwards of 300 drug recognition experts. See training process in this document (Recommendations, pg.5).

Recommendations from Mary Maguire,
AAA Northeast

12. A requirement that the Commonwealth recruit and train an additional 100 Drug Recognition Experts to assist in identifying drug-impaired drivers on MA roadways (Recommendations, pg.17).

Funding & Training Cont.

Recommendations from Matthew Allen
American Civil Liberties Union – Massachusetts

13. The ACLU is not opposed to increasing funding for training and validation (or invalidation) of the accuracy of Drug Recognition Experts in Massachusetts. If and when the DRE exam is scientifically validated, the ACLU would support training to ensure that DREs are following evidence-based protocols (Recommendations, pg.17).

14. The ACLU recognizes that the lack of scientific evidence validating DRE exams is a barrier to admitting results in court, and recommends that the state fund scientifically valid studies to determine how and whether DRE test results correlate to the recent use of various drugs and actual impairment as a result (Recommendations, pg.17).

Funding & Training Cont.

Recommendations by Dr. Alan Ehrlich, MD FAAFP., of the
Massachusetts Medical Society

15. Funds should be allocated to support research into the following areas:
    i. Reliability of DRE for assessing cannabis use. Research needs to include individuals with demographic characteristics (age, race) to ensure its validity across the various populations in Massachusetts that might be affected.
    ii. Duration of impairment following cannabis consumption both inhaled and orally, and in intermittent users as well as chronic users. Again, appropriate demographic groups must be represented in the research populations
    iii. Until there is a reliable noninvasive method for assessing acute cannabis ingestion, funding should be made available to test new technologies as they are developed.
    iv. Additional funding for more DRE trained officers should be allocated but I would not recommend making DREs mandatory (or risk loss of license), until there is better data presented on the validity of the DRE evaluation (Recommendations, pg.18).

ARIDE

Recommendations from Chief Carmichael
Massachusetts Chiefs of Police Association

16. ARIDE: Train ALL Massachusetts police officers in ARIDE, including recruits in the academies. Massachusetts should study the validity of standardized field sobriety testing. Massachusetts should also study the correlation between marijuana and impairment detection using assessments such as the modified Romberg and lack of convergence assessment. The CCC research demonstrates efficacy in assessments, which are indicative of THC consumption & impairment, and should be accepted as valid measures of THC use as in the ARIDE Manual - National Highway Traffic Safety Administration (Recommendations, pg.4).

Recommendations from Mary Maguire,
AAA Northeast

17. A requirement that all law enforcement officers in the Commonwealth become ARIDE (Advanced Roadside Impaired Driving Enforcement) certified, with funding for this initiative derived from taxes generated through the sale of recreational marijuana (Recommendations, pg. 17).

Horizontal Gaze Nystagmus

Recommendations from Chief Carmichael

Massachusetts Chiefs of Police Association

18. Horizontal Gaze Nystagmus: Officers should be permitted to testify to nystagmus tests. Massachusetts should look at states such as Maine, where officers routinely testify to nystagmus in OUI drug cases and study HGN validity (Recommendations, pg.5).

Recommendations from Undersecretary Jennifer Queally, Chief Legal Counsel David Solet

Executive Office of Public Safety and Security

19. Adopt Statute Making Properly-Administered HGN Test Admissible (Recommendations, pg.9).

Implied Consent

Recommendations from Chief Carmichael
Massachusetts Chiefs of Police Association

20. Implied Consent: Require Implied Consent for DRE: Massachusetts should apply implied consent to DRE assessments as we currently do for breath & blood testing. Police should not be forced to file immediate threat for OUI drugs under MGL Ch. 90 § 22. Impose the same requirements and sanctions for drug testing that currently apply to alcohol testing. Test for breath, blood, urine (implied consent) (Recommendations, pg. 5).

Recommendations from Matthew Allen
American Civil Liberties Union – Massachusetts

21. The ACLU is opposed to an "implied consent" law that would suspend the licenses of motorists who refuse to give blood, oral fluid, or submit to a Drug Recognition Expert (DRE) exam until such a time that scientific evidence has successfully demonstrated that these tests effectively and accurately measure impairment (Recommendations, pg.16).

Per Se Procedures

Recommendations from Chief Carmichael

Massachusetts Chiefs of Police Association

22. Tandem Per Se : Massachusetts should adopt tandem per se procedures for when the sequence of events includes the officer's observations in addition to the operator having an amount of impairing substance in their system. Massachusetts should support administrative license revocation for positive roadside drug tests and/or refusal to provide a biological sample for evidential testing (Recommendations, pg. 5).

Per Se Procedures

Recommendations from Chief Carmichael

Massachusetts Chiefs of Police Association

23. Oral Fluid Testing/THC Breath Test: Massachusetts should adopt the application of oral fluid testing as part of tandem per se. The Office of Alcohol Testing would perform the selection process of the devices and the MPTC would be responsive to requests for training related to fluid testing processes and devices. As an example, oral fluid testing devices such as Drager DT5000 , Drug Wipe5, Alere DDS2 have been shown to provide adequate sensitivity, specificity, accuracy, positive predictive value & negative predictive value. Oral fluid testing identifies drugged drivers proximate to the traffic stop and reduces the chance of diminished results, which may be delayed through DRE, & blood, urine tests hours later. As an alternative to tandem per se, oral fluid testing could be used in same manner as a portable breath test device. Offer the oral fluid test at roadside once probable cause is established and in the event of a positive test, use as a preliminary drug test prior to a DRE (Recommendations, pg.5).

Per Se Procedures

Recommendations from Matthew Allen

American Civil Liberties Union – Massachusetts

24. At the present time, the ACLU is opposed to creating a "per se" limit of THC in the blood that would constitute impairment under the law because there is no evidence that a specific level of THC in the blood is correlated to impairment for everyone or most individuals. Furthermore, there is evidence that such a policy would disproportionately and unfairly impact medical cannabis patients (Recommendations, pg.16).

25. The ACLU is not opposed to creating a "per se" limit of THC in the blood or in oral fluid if and when scientific tests establish a correlation between levels of THC and impairment with similar accuracy and specificity to the breathalyzer used for alcohol (Recommendations, pg.16).

Warrants

Recommendations from Chief Carmichael
Massachusetts Chiefs of Police Association

26. Warrants: Massachusetts should implement electronic warrants to reduce delays in taking blood samples (Recommendations, pg.6).

Recommendations from Undersecretary Jennifer Queally, Chief Legal Counsel David Solet
Executive Office of Public Safety and Security

27. Facilitate Use of Judicially Authorized Search Warrants to Efficiently and Humanely Acquire Blood Samples to Test for Drugs and Alcohol (Recommendations, pg.12).

Warrants

Recommendations from Matthew Allen

American Civil Liberties Union – Massachusetts

28. The ACLU emphasizes that blood tests of motorists should never be permitted unless law enforcement agents have obtained a warrant (Recommendations, pg.17).

29. At such time as blood or saliva tests are developed to effectively and accurately measure impairment, the ACLU is not opposed to establishing procedures that would allow law enforcement agents to expedite requests for warrants to draw blood or saliva from motorists suspected of operating under the influence (Recommendations, pg.17).

Public Awareness

Recommendations from Matthew Allen

American Civil Liberties Union – Massachusetts

30. The ACLU supports funding public service messages and other education programs to educate motorists about the risks of driving under the influence of cannabis and other drugs (Recommendations, pg.17).

Recommendations by Dr. Alan Ehrlich, MD FAAFP., of the

Massachusetts Medical Society

31. Educational public service announcement campaigns should be developed to promote awareness of the dangers of driving after cannabis use. Specific programs should be developed for incorporation into Driver's Ed (Recommendations, pg.18).

Public Awareness

Recommendations from Mary Maguire,
AAA Northeast

32. A requirement that all Massachusetts marijuana dispensaries are to provide printed informational materials to customers with safety messaging focused on recreational marijuana and impaired driving. These materials are to be included inside bags of all product sold at the dispensaries. (AAA Northeast and the MA Highway Safety Division are currently preparing materials.) (Recommendations, pg.18).

33. A requirement that a marijuana/impaired driving module be added to the Massachusetts driver education curriculum (Recommendations, pg.18).

34. A requirement that the commission recommend that funding be provided for a public awareness and education campaign outlining the dangers of driving under the influence. This campaign would include the Massachusetts Highway Safety Division, the Department of Public Health, and other traffic safety stakeholders (Recommendations, pg.18).

Recommendations from Chief Carmichael

Massachusetts Chiefs of Police Association

35. Consensus: OUI Commission should accept research and studies, which support the fact that THC can cause impairment in motorists. THC impairs motor function, reaction time, tracking, cognitive attention, decision-making, impulse control, memory (Recommendations, pg.4).

Recommendations from Chief Carmichael

Massachusetts Chiefs of Police Association

36. Preliminary Testing: Any operator who fails a preliminary drug test should be required to submit to evidentiary drug testing (Recommendations, pg. 6).

Recommendations from Chief Carmichael

Massachusetts Chiefs of Police Association

37. Crash Testing: Massachusetts should have mandatory admissible drug testing in ALL crashes resulting in death or serious bodily injury (Recommendations, pg.6).

Recommendations from Chief Carmichael

Massachusetts Chiefs of Police Association

38. Poly-Drug Penalties: Being under the influence of multiple drugs increases the risk of crash. Massachusetts should adopt enhanced/increased penalties for Poly-Drug Use, including alcohol & marijuana use (Recommendations, pg. 6).

Recommendations from Chief Carmichael

Massachusetts Chiefs of Police Association

39. BAC Limit: Massachusetts should eliminate statutory presumption of innocence of .05% BAC, when other psychotropic drugs are also present (Recommendations, pg. 6).

Recommendations from Chief Carmichael

Massachusetts Chiefs of Police Association

40. Phlebotomists: Offer training (Recommendations, pg. 6).

Recommendations from Undersecretary Jennifer Queally, Chief Legal Counsel David Solet

Executive Office of Public Safety and Security

41. Adopt California-style "Alcohol or Any Substance" Definition of OUI (Recommendations, pg. 6).

Recommendations from Undersecretary Jennifer Queally, Chief Legal Counsel David Solet

Executive Office of Public Safety and Security

42. Adopt Legislation Imposing Administrative License Suspension for Noncompliance with Oral Fluid Testing and DRE Examination (Recommendations, pg. 13).

Recommendations from Undersecretary Jennifer Queally, Chief Legal Counsel David Solet

Executive Office of Public Safety and Security

43. Make Explicit that Drug Concentration Evidence is not a Precondition to Admission of Evidence of the Presence of an Impairing Substance (Recommendations, pg.14).

Recommendations from Undersecretary Jennifer Queally, Chief Legal Counsel David Solet

Executive Office of Public Safety and Security

44. Eliminate Public Way Requirement (Recommendations, pg.15).

Recommendations from Matthew Allen
American Civil Liberties Union – Massachusetts

45. The ACLU recommends that the legislature require all law enforcement agencies to collect and share with the public data on motor vehicle stops, including the race, age, and gender of the motorists and the result of the stop (Recommendations, pg.17).

Recommendations from Matthew Allen

American Civil Liberties Union – Massachusetts

46. The ACLU is opposed to suspending the licenses or creating new criminal penalties for motorists who cannot pay fines. License suspension due to nonpayment of fines disproportionately and negatively impacts low income individuals in rural areas who need to drive in order to work, transport family members to medical appointments, and complete other life activities. If the legislature institutes a policy that includes license suspension for nonpayment of fines, reduced fees or payment plans should be made available to low income individuals (Recommendations, pg. 17).

Recommendation from Sabra Botch-Jones
Scientific Testing and Data

47. A laboratory based confirmatory test should take place to confirm presumptive findings (Recommendations, pg.20).

Appendix B: Special Commission Minutes and Recorded Votes

Special Commission on Operating Under the Influence Meeting Minutes

June 13, 2018

Arlington Police Department

112 Mystic St

Arlington, MA 02474

LIST OF DOCUMENTS: Agenda

S. Collins began the meeting at 10:18 a.m. Housekeeping, this is a public meeting that was posted on the Commission's website, as well as circulated ahead of time. As a public meeting, everything done at these meetings will be public. 00:34 S. Collins asked if the meeting was being recorded, and received an affirmative. He also announced that the Commission was also recording the meeting for the purpose of taking minutes.

Collins began introductions. Beginning with staff, he introduced David Lakeman, Maryalice Gill, and Commissioner (Britte) McBride.

Collins then indicated that the OUI commission is not a subcommittee of the CCC, nor a special commission of the CCC. Meeting is pursuant to statute, Section 50 of Chapter 55, of Acts of 2017, which also lays out the mission of the Commission. The Commission must report to the Legislature by January of 2019.

Collins then began introductions around the table. He began to his left.

Shawn Collins (Chair)- Massachusetts Cannabis Control Commission Executive Director
Alan Erlich- here on behalf of the Mass. Medical Society and have spoken on medical marijuana. MMS
Matt Allen- representing the ACLU of MA.
John Scheft- representing AG, an attorney who has spent 25 years training police officers.
Patrick Bomberg- Bristol Assistant DA, there on behalf of DA Thomas Quinn who is on the commission but unable to make.
Dr. Margarita Alegria - psychologist at Harvard medical school in dept. of medicine and psychiatry, has done research in substance abuse for the last 12 years, and member of national academies of medicine cannabis report.
Peter Elikan- MassBar Association, is criminal defense attorney.
David Solet- Executive Office of Public Safety and Security
Mary Maguire- Director of Public and Legislative Affairs- AAA NE. AAA has done a lot of research on the issue of drugged driving.

S. Collins thanked everyone for making time to meet. He also thanked the Arlington Police Department and (Arlington Chief of Police) Ryan for hosting the commission.

Collins said that judging by the agenda, there is a lot to look at, and today it is his intention to make introductions, and to map out process moving forward, and how the commission is going to meet, convene, and discuss with a goal of getting the report to the Legislature by January 2019.

On the agenda is a list of topics pulled from the statute that the Commission is tasked with reviewing and discussing with the goal of developing recommendations to the legislature.

Collins said he thinks it's best to go through these issues, then discuss how best to go about addressing them.

In order, the discussion agenda is:

b. medical types of testing and data

c. possible new technological forms of testing

d. civil liberties of the operator

e. social economic aspects of the testing

f. admissibility of evidence of impaired driving in court proceedings

g. burden on law enforcement

h. the current status of law within the commonwealth

i. training of law enforcement

j. intrusiveness of tests

k. cost analysis of testing

l. the current threshold for determining impairment

m. the rate of success in stopping impaired operators

n. anything else the commission deems necessary or significant

Collins paused to introduce Walpole Chief of Police John Carmichael, member of Cannabis Advisory Board as public safety representatives.

Collins said that "Operating Under the Influence" also covered other drugs and substances covered under Chapter 94C. Cannabis is certainly important, but there are other elements to be covered, including anti-depressants and stimulants, and wanted to be sure that this was covered, as well.

Collins raised the possibility of breaking into Subcommittees or smaller groups to tackle individual issues then to reconvene to full board to discuss. Asked for comments on organization.

Dr. Alegria recommended dividing into certain subcommittees to take advantage of specialites more aligned with certain people. For example, certain kinds of testing and data, more of the issues dealing with these aspects might be for a special group, while there seems to be more of the evidence and enforcement seems to be more geared toward to a different group, and we would come back to the bigger group for different views.

A. Ehrlich said that this made sense to him, given that each area had so much information that would be helpful for the whole group.

P. Elikan agreed, as a defense attorney there were things he knew, but would be clueless and lost on medical science and data. Rather than everyone be generalists, where everyone does everything, maybe the group should stick with where experience and background is.

S. Collins said that the diversity of issues reflected overall complexity of the topic, so the panel represents the myriad of expertise that is needed, and we hope to leverage and take advantage of that experience to then bring back to the whole group to tie things together in a more comprehensive manner.

Collins then asked if the group would want to group the issues, then volunteer members to spearhead certain issues. Given the deadline of January 2019, the group needs to map out goals and pace work accordingly to ensure a sufficient amount of lead time to put together a draft with all perspectives and comments, then to be sure that the group is as aligned as possible when making recommendations.

J. Scheft said he didn't know how best to organize themselves, brought up success of alcohol program, said that the success was based on scientifically valid standardized field sobriety tests. A breathalyzer machine is essentially reliable as a established standard of impairment of .08, which makes a huge difference. He said that the National Highway Traffic Safety Administration shows reduced evidence of driving with alcohol, but more cases of drugs or "combo" driving, with alcohol and drugs, such as Percocet. Everyone is looking for the "silver bullet" for drugs like a breathalyzer, but not yet. The other issue is that things we have now is that we have national program for Drug Recognition Experts (DRE), and one of the things we have seen in MA is that there is not the training for DREs or consistent acceptance in court. One of the pieces of legislation proposed by DA Mike Morrissy would say that if you refuse to undergo DRE exam then you lose your license, just as if you refuse breathalyzer. This suggests that we need a technological subcommittee, but also a subcommittee on what we can say right now to police officers on sobriety testing and DREs being accepted in the courts of the commonwealth so that there is a consistent expectation. 12:20

M. Maguire agreed, and in anticipation of this need AAA is putting together a DRE court training in October, and will continue to do that on an ongoing basis, because it's going on now and we need better training now.

M. Alegria said that it's also very important to inform the public, because it's very new and informing the public of what we know and what we don't know is very important. Important to note that much information is very tentative.

J. Carmichael offered agreement for J. Scheft's point regarding the need for standardized testing, and that the state needed something that would hold up in court. As a chief, he also sees an issue for budgeting and how depts. are going to pay for these things. In CO, chiefs immediately had to pay $1.4 million to provide ARIDE and DRE training. In departments such as Walpole, if he send a couple of officers to ARIDE, it's three days of training, but also time he has to back-fill time. DRE is three weeks, and while there are grants, many smaller departments have difficulties dealing with back filling time. Hopefully with taxation moving forward some of the money will be allocated to training.

S. Collins said that he failed to introduce CCC Research Director Julie Johnson. CCC put together law enforcement survey yesterday related to taking stock of which departments had DRE or ARIDE training, what some hurdles may be in achieving that, figuring out what resources are available across the commonwealth. Then to chief's point not just money but also administrative support. Collins promised to not only share that information with the OUI commission, but also with the full CCC.

P. Elikan agreed with J. Scheft. As criminal defense attorney, he defended hundreds of people from DUI charges with alcohol. Stated that it is extremely rare to see someone charged with operating under any other substance than alcohol. On rare times when it happens, criminal defense attorneys ask how it will be proved, and in most cases is dismissed. Says that there is something fundamentally wrong when drugs can impair as much as alcohol but people operating with any substance other than alcohol has gotten a pass. Says this reinforces the importance of the commission.

M. Allen shared these concerns from perspective of the ACLU, to ensure that any solutions raised here are done with respect for people's civil liberties. Also want to make sure that all of the recommendations that the commission supports are based in evidence. Folks have made good points about gaps in data, one of the concerns is that out of the gate we don't operate off of some assumptions that are not proven by data. Want to be sure that we don't start operating under assumptions that may not be fact, such as that there are more people operating under influence of cannabis. Testing by blood may not represent intoxication, even if some amount is present in the blood. No doubt that driving that driving under influence of any substance is dangerous, and should address that. Looks forward to learning more about DREs. There is an assumption that these training are the best solution, but would like to know more about DRE training, and how they make the determination when they're out on the road. Much work ahead of the commission, and Allen is grateful for everyone working on this. Suggests that maybe for splitting into subcommittees they review all of the categories for discussion. For instance, the social economic aspects of the testing, he's not sure exactly what that means. Figuring out these questions would be helpful.

M. Alegria raised question that for subcommittees, whether there was a possibility for bringing in experts for new information so that the Commission benefits from the most up to date information, because there is a lot of new information being generated, and we could benefit.

A. Ehrlich agreed. Believes that the cautions are valid, but that the only way to get to the heart of matters is to have access to latest data for a rapidly changing field. Current products being field-tested for breath tests for marijuana. Didn't know how long before they come to market, but wouldn't be surprised to see it soon. The starting point has to be, let's get the most recent and scientifically accurate information out to the commission.

S. Collins agreed, the best way to manage that give all of the material available on this topic, to make sure everyone has access is that everyone sends those materials to the CCC, we can distribute it to everyone, and as early as possible to give time to think about the issues. That might be best way to manage it to send it through David (Lakeman) to ensure that everyone has access. Pull together library of resources for references, use it for works cited or bibliography for report. Bring in speakers or experts to testify to group.

M. Maguire raised point about bringing in people with expertise, cited Boston Herald piece on people who had been impacted by drugged and drunk driving.

S. Collins raised the issue of these topics and what they mean to the commission, and how we can examine them effectively. Did not have input in how things were phrased at legislature, but wonders if anyone had insight as to what is meant by social impact.

M. Allen expressed confusion about the legislative intent of the section. Wonders if that means that when implementing any kind of law enforcement or intervention in a population where folks have been disproportionately impacted or from a disadvantaged background, if that's what the legislature meant, or if it's a greater question about testing for marijuana.

M. Alegria said that one thing that could make a big difference is health literacy of intended population. Could determine how people respond, and is important to have standardized assessment. Even assessment of what law enforcement asks, we want to standardize it. The language, the health literacy, might influence how they respond, even at first entry. We should take all of those things into account when considering fairness of the process.

J. Carmichael agreed with M. Allen that civil liberties issue is an important one. Also said that officers want to have tools necessary to do the job of assessing drug use and then to follow through on that assessment. Also reminded group that DREs not accepted in all courts. Judicial standards necessary. Currently examination takes 2.5 hours for DRE officer in the station. If there is an increase in drugged driving, there is also a time element in increased testing. Also a cumbersome process.

J. Scheft raised issue raised in recent criminal justice reform, when people enter the criminal justice system, there are things that you have to pay for. MA just got rid of probation for failing to pay reinstatement fees for license. There are a lot of money implications, might not be able to afford good lawyer. Should be aware of this issue, and fair about that without sacrificing public safety. Doesn't want commission to become a catalog of technical issues and solutions. There are issues now that we see, for example a standard field sobriety test is accepted in many states but not MA. Suggested we look at OUI statute.

S. Collins believes that the Commission is not limited to listed items, given the final item listed by statute, but should take care to address actual listed issues. Collins sees a natural break down in terms of subcommittees based on topic and interest of person. Suggested that during the next meeting the subcommittee breakdown could be formalized. Asked for firm number of subgroups to identify. Three he thinks are medical, law enforcement, and technological.

A. Ehrlich and M. Alegria disagree that medical and technological are separate. Ehrlich suggested legal, technical, and social as areas of breakdown.

S. Collins suggested that technology impacts all parts of this question. All groups would have freedom to define scope of their work.

M. McGuire asked if issues like traffic safety and public safety would fall under law enforcement, or separate group.

Collins said he was open to this based on the opinion of the group, but law enforcement would have strong interest.

J. Scheft suggested looking to implied consent testing, discussing protocols for preservation orders for blood in hospitals and the need for consistency. He then also raised the issue of open container of marijuana- ticket has to be done under local ordinance, not state law. Open container marijuana under state statute. Parity between issues. Parity between alcohol and marijuana means that the ticket for both offenses should be the same.

Dr. Ehrlich discussed scientific evidentiary issues, also admissibility of evidence and thresholds of impairment. Some guidance as to what would be useful is helpful.

J. Carmichael brought up AAA Report on toxicology, that sometimes fatal crashes are below established THC level. Asked how does marijuana impact each individual?

M. Allen mentioned that some THC blood tests are from bodies from fatal crashes, but raised issues on civil liberties with roadside blood tests, suggested there may be other routes to be considered. C. Carmichael said that there is also an issue with cost for these tests, established expense of blood test at $250.

M. Maguire raised the issue that there is no real .08% standard or equivalent for marijuana. There are too many different factors: when did you smoke? What was the THC content? Are you a chronic user or first time user? Are you smoking or ingesting edibles? This is an issue with establishing standards.

P. Elikan said that THC stays in your system for almost a month, longer than most substances. With alcohol you can tell if it were used recently. Marijuana does show a difference for chronic use and once or twice.

M. Allen suggested that a public awareness campaign would be helpful with several of these issues, S. Collins responded that many agencies, including the CCC, have been charged with crafting a public awareness campaign and that it is important to help not just detect OUI but also to prevent it.

M. Alegria raised issue of offering information in languages other than English and public messaging, and suggested looking at the message with reference to vaccination campaigns.

S. Collins mentioned that the commission has added to listed topics, as opposed to narrowing it, but good progress on organizational topics. Referenced Dr. Ehrlich's desire that each topic should be addressed in a cross-expertise manner.

M. Alegria suggested potential groupings.

J. Scheft suggested that he would look at current procedure for police on the street and whether they would give a presentation to the commission. Medical members could look at further issues they wanted to explore further. Subcommittees may not be needed, but some individual legwork and agenda-setting would be appropriate.

M. Allen asked how many meetings S. Collins anticipated. Collins did not, but moved to next agenda item, how often to meet. M. Allen asked if the Special Commission was subject to open meeting law, that no meeting could be taken without quorum and public notice. S. Collins confirmed that the commission is under open meeting law.

M. Maguire raised the issue that she'd been approached by the *Boston Herald,* and asked if it would make sense to appoint a spokesperson for the group.

D. Solet expressed interested in presentation by officers from patrol. Solet then offered toxicology support. Trial court would be first stop for information on cases.

S. Collins asked if the group would want to break agenda items down into presentation group items rather breaking up into subcommittees, with reference to difficulty of scheduling during summer months.

Dr. Erlich raised possibility of breaking up presentations into 20-min chunks, reporting to full group. Requested any materials to be distributed prior to any meetings for review, given issues with presentations. S. Collins agreed.

M. Maguire offered volume of AAA research on this topic.

S. Collins discussed data compilation, raised scheduling.

D. Lakeman raised issue of remote participation.

M. Maguire raised issue of meeting once every two weeks.

S. Collins agreed with idea of regular meetings.

Group discussed possible dates, settled on July 3rd at 3 p.m. with a location to be determined by the CCC staff. 1:01:20

S. Collins raised issue of voting for remote participation. P. Elikan made motion to allow for members to call in for remote participation, so long as a physical quorum is present. seconded by D. Solet. Roll Coll followed-unanimous approval. 1:02:39

Alan Erlich-yes
Matt Allen- yes
John Scheft- yes
Patrick Bomberg- yes
Dr. Margarita Alegria - yes
Peter Elikan- yes
David Solet- yes
Mary McGuire- yes
John Carmichael- yes

Next Meeting Tuesday July 3rd at 3 p.m.

M. Alegria made motion to adjourn, seconded by D. Solet at 11:21 a.m. 1:03:24

Special Commission on Operating Under the Influence Meeting Minutes

August 10, 2018

Massachusetts Gaming Commission

101 Federal St., 12th Floor

Boston, MA 02110

LIST OF DOCUMENTS: Agenda, Operating Under the Influence of Drugs: Assessing the Scope of the Problem in Massachusetts

Shawn Collins began the meeting at 1:06 PM. Mr. Collins asked if the meeting was being recorded and received an affirmative. Mr. Collins also announced that the Commission was recording the meeting for the purpose of taking minutes. He introduced Mr. David Solet, from the Executive Office of Public Safety and Security, for a presentation prepared by his office. Mr. Solet presented a presentation titled "Operating under the Influence of Drugs: Assessing the Scope of the Problem in Massachusetts, which can be viewed in the links above.

- Mr. Solet explained that it is hard to know why prosecutions dropped in 2014. Mr. Solet suggested that it could also be because of greater educational efforts around operating under the influence of drugs. Mr. Solet made an educated guess that prosecutions are so low because under current state of law it is difficult for police to identify drug intoxication in court.
- This is partly due to the lack of a breathalyzer equivalent for drugs, Mr. Solet said, and partly due to the need for more DRE training.

Undersecretary Queally discussed the difference between prosecuting alcohol vs. drugs, noting that with alcohol there is no difference in court between different alcohols (e.g. wine vs. vodka tonic), but with drugs the burden is on the prosecution to positively identify precisely which substance is causing a person's impairment.

- Chief Carmichael added that addiction to substances happens between ages 11-21. Addiction rates decline after this. Chief Carmichael suggested that the state should be looking at how many kids have used drugs or marijuana, and how early onset was.

Mr. Collins inquired where the group wanted to go next in presentations. Special Commission members offered topics, including covering the scope of the problem, Ms. Maguire and Dr. Alegría offered to present at the next meeting. Ms. Maguire suggested asking Det. Lt. Halloran of the State Police if he would be willing to present.

Mr. Collins then turned to timing and suggested that the next challenge was how the group would meet its deadline. Mr. Collins asked if the commission thought it would be feasible to have a series of recommendations or topics at least by Thanksgiving, which would give the commission time as a group to set next timelines.

Chief Carmichael mentioned that with the increase in OUI cases, an important number to watch is the number of Drug Recognition Experts (DRE) across the state.

- DRE numbers were as low as 50-60 across the state a few years ago, he said, but there are now approximately 150. Mr. Collins mentioned that Commission just issued a survey asking about

DREs and what the hurdles would be to add more. At last meeting, Chief Carmichael listed the resources and time needed to get more DREs out and trained.
- Chief Carmichael mentioned that the state DRE organization tracks refusals. Chief Carmichael does not know number but knows that it is not very high because of implied consent with DREs. He then clarified the difference between DRE training and ARIDE training and offered an online location where training materials can be viewed.
- Undersecretary Queally suggested that it would be helpful to ascertain how many judges across the Commonwealth accept DRE testing.
- Ms. Maguire offered to reach out to Sgt. Don Decker, statewide DRE coordinator, to ask him to present.

Undersecretary Queally shared that EOPPS recently rolled out their public awareness campaign, and Mr. Collins added that the Commission also has a campaign underway regarding youth access, consumption, and driving, as well. Mr. Collins cited the need to discourage activity before it becomes a law enforcement issue.

- EOPSS and Highway Safety Division did a press release with a new PSA on issue of impaired driving, with focus on marijuana with coming of retail sales beginning soon.
- Undersecretary Queally stressed that the amount of people driving while impaired from alcohol has steadily declined over 40 years, as driving under the influence went from being seen as fine to really socially unacceptable, while the reverse has happened with marijuana, and she said she is hoping that does not stay a trend and people realize that it absolutely causes impairment.

Mr. Collins said on Thursday the Commission had public discussion and public unveiling of sorts of public awareness campaign with DPH on introduction of adult use marijuana.

- The first part was getting data from focus groups, so we could target it best toward what folks need. Included getting information on types that might be available, tips on talking to your kids, etc. Many surveys and focus groups.
- The next step was collecting data to determine whether it's still successful. The program is heavy in digital content and can be viewed at Allaboutmj.org. Materials are posted from all sources, also some videos meant to be friendly and softer.
- Ms. Maguire and Undersecretary Queally voiced support for the public awareness campaign and cited the campaign to increase seatbelt use in MA.
- Mr. Collins explained that the Commission has consulted with other states and intends for the Commission to become a warehouse of data such as this.
- Undersecretary Queally mentioned numbers from Colorado. Undersecretary Queally also mentioned that EOPSS is required to do a public awareness campaign but has no funds from the Legislature to do so. Mr. Collins suggested that the issue be a part of the Special Commission's report to the Legislature.

Mr. Collins asked members to look at staff proposed next dates. Undersecretary Queally mentioned that November 9 is a holiday. Members agreed to lock in September 14 and October 12, and consider extra dates.

Ms. Maguire made the motion to adjourn, Dr. Alegría seconded, unanimous vote to adjourn at 2:16 PM.

Special Commission on Operating Under the Influence Meeting Minutes

September 14, 2018

10:00 a.m.

Massachusetts Gaming Commission

101 Federal St., 12th Floor

Boston, MA 02110

LIST OF DOCUMENTS: Agenda

Chair Collins began the meeting at 10:14 a.m.

The Commission discussed approving minutes from August 10 meeting. At the suggestion of D. Solet of EOPSS, the Commission declined to vote on minutes pending revision of minutes.

Collins introduced Sgt. (Retired) Don Decker, the Mass. State Drug Evaluation and Classification Coordinator. Sgt. Decker presented to the Commission on Drug Recognition Expert Programs. Sgt. Decker answered questions from Commission members.

The Commission discussed the presentation.

The Commission discussed meeting more frequently through the months of October, November, and December to complete its report.

The Commission adjourned with a unanimous vote at 12:08 p.m.

Special Commission on Operating Under the Influence Meeting Minutes

October 12, 2018

Massachusetts Gaming Commission

101 Federal St., 12th Floor

Boston, MA 02110

LIST OF DOCUMENTS: Agenda

Chair Collins called the meeting to order at 1:04 p.m. He noted that the meeting was being recorded.

Collins moved on to the minutes. The Commission had two sets of minutes to approve, one set from August 10th and one from September 14th. Both sets were approved unanimously.

Collins introduced Mary Maguire, Director of Public & Legislative Affairs for AAA Northeast, in order for her to begin her presentation, "Marijuana and Driving".

- Studies show that some believe that they are more competent drivers when under the influence of marijuana.
- Marijuana (including smoke, vape, or edibles) is the second most commonly found drug after alcohol in drivers involved in collisions. This is more than other drugs, including opioids. Alcohol is still the single greatest driver of deadly crashes.
- TCH enters the blood stream more quickly when smoked than when consumed as an edible.
    - Edibles present a unique challenge, because it has a delayed impact. This means some users may consume and think they are able to drive, with the THC having an impact after they are already on the road.
- THC impacts brain functions most essential to driving, including concentration and coordination.
- AAA completed a study in Washington from 2010-2014, looking at changes in fatal changes after recreational marijuana was legalized.
    - From 2010-2014, 10.0% of drivers involved in fatal crashes had detectable THC in their blood at the time of the crash
    - Of all THC-positive drivers involved in fatal crashes, an estimated 34.0% had neither alcohol nor other drugs in their blood
    - In 2013, after recreational marijuana was legalized in 2012, the number of fatal crashes doubled from 49 in 2013 to 106 in 2014
    - Analysis of trends over time before and after Initiative 502 took effect indicate that the proportion of drivers positive for THC was generally flat before legalization, but began increasing significantly about 9 months after the effective date of legalization.
- AAA study showed that there is not a .08 standard, as THC affects different users differently, which makes consistent guidelines difficult. There is not a direct connection between THC blood levels and impairment.
- Rather than per se laws, AAA recommends requirements for positive tests of recent marijuana use and behavioral and psychological evidence of impairment (which would be heavily reliant on drug recognition experts and their testimony).

Maguire noted that the following week AAA would be giving a courtroom training for approximately 50 DRE officers. She mentioned that there are currently about 147 DREs in Massachusetts.

At the conclusion of her presentation, Maguire answered questions from Commission members.

- Maguire reiterated that there is no existing test that can demonstrate with certainty recent use.
- J. Carmichael noted that active THC, or hydroxy THC, is active in user systems for up to 24 hours and can cause impairment. Carboxy THC, which is inactive, stays in the system for up to 30 days.
- P. Elikann noted that you can tell recent versus past use based on THC levels, and that the liver will metabolize it within a few hours.
- J. Queally noted that fatalities have increased from 2015-2017. She also asked if there was a training for judges to consider DRE testimony. Maguire responded that AAA did numerous programs with the judiciary, but not specific to the issue.

Maguire concluded her presentation. Collins introduced Dr. Margarita Alegría, Chief of the Disparities Research Unit at Massachusetts General Hospital, and a Professor in the Department of Psychiatry at Harvard Medical School, to begin her presentation; "An overview of existing literature on the impact of cannabis on cognitive functioning, methods of testing impairment, and the challenges posed by synthetic cannabinoids".

- Studies demonstrate that higher levels of THC impair judgment, reaction times, time perception, and working memory.
- A study by Sewell et al. (2009), found that more frequent marijuana users show less driving impairment than infrequent users do at the same dose, likely since frequent marijuana users build up physiological tolerance and learn compensation behaviors.
- Studies also show that that impaired drivers tend to be more cautious and aware of their impairment, overcompensating for their perceived impairment, which starkly contrasts the behavior of drivers under the influence of alcohol and cocaine.
- One of the chief medical difficulties is that there is not a linear relationship between use and level of impairment.
- To determine the level of impairment of drivers under the influence of cannabis, several authors have proposed two approaches:
    - Associate the influence of acute effect of cannabis on driving with specific THC blood levels. THC blood level is known to reach a peak of concentrations within 10 min, before dropping rapidly, remaining detectable for about 4–8 hours. However, the correlation between THC blood levels and the cannabis effects responsible for driver's impairment appears to be non-linear.
    - The duration of impairment due to cannabis smoking observed in some pharmacodynamical studies and a back-extrapolation of THC concentrations in blood during driving is difficult due to an unknown time after intake and interindividual variability in rates of decrease. This leads them recommend that the blood sample be collected by trained officers at the start of impairment evaluation.
- Two tests in progress of being evaluated:
    - European Roadside Testing Assessment (ROSITA) project
        - Started at the end of the 1990s by the European Union to evaluate 9 commercial brands of on-site drug testing devices that included cannabis.
        - The detection limit values are set by NIDA with the screening cut-off level for THC being 50 ng/mL. The ROSITA project uses the SAMHSA guidelines recommendation for THC in oral fluid of a cutoff level of 4 ng/mL and a confirmation cutoff level of 2 ng/mL.

    - Dräger Drug Test 5000
        - a test that can be performed on-site at a traffic stop to screen samples of oral fluid for drugs
- Ultimately this is a difficult topic from a testing standpoint and there are not a lot of firm answers yet.

Dr. Alegría concluded her report and took questions from the Commission.

- P. Elikann asked if there was a difference between marijuana use and alcohol in terms of impacts on different body types. M. Alegría said there is a large difference between self-reporting, in that individuals who are under the influence of alcohol tend to think they are less impacted than they are, while individuals with marijuana think they are more. There is too much variability in how different individuals react to measure based on other physical factors.
- J. Queally asked about the relationship between chronic users and new users, and how to establish a number, such as .08 with alcohol. In the European approaches any impairment or presence of THC generates a fine while driving.
- M. Allen asked about the randomized nature of the studies shown in the presentation, and if the pre-status brain scan had to be included in the study in the post-use image was used. She answered that it did not.
- M. Alegría explained that part of the problem of having a clear prevalence is because the studies are not made taking a random sample of everyone, but rather people that allow themselves to be tested. Fatalities are people that have been stopped and that is not a random sample. That is a very biased sample that you have and then you're making estimations based on that and that's where the problem comes.
- M. Allen asked if Dr. Alegria saw proof that the studies suggested that the DRE program is extremely reliable or less reliable at effectively measuring impairment. She said that according to the literature it was less reliable, because those tests don't necessarily correlate leads in the studies that have done double blind validating. They have not found such high reliability of using just the standardized sobriety tests.
- D. Solet asked if the intention of those who are doing this research that at some point this will be low-cost and portable such that it would actually be at a police station. Dr. Alegria responded that the intention is to have it be a roadside test that is portable, quick, commercially available, and reliable.
- J. Carmichael and Dr. Alegria discussed the differences between some of these tests and current DRE tests.

Dr. Alegría concluded her report.

Dr. Ehrlich asked a general question to the commission, seeking to know how good was good enough for them, what degree of false positives and false negatives the commission would be comfortable with.

The Commission discussed this question.

Upon the conclusion of the discussion, S. Collins offered to send any materials that members wanted to disseminate to the Commission. He then noted that the next meeting was scheduled on Friday, November 9th from 1:00 to 3:00 p.m. He invited members who had not yet presented to contact him to do so.

The meeting was adjourned at 2:52 p.m.

Special Commission on Operating Under the Influence Meeting Minutes

November 09, 2018

Massachusetts Gaming Commission

101 Federal St., 12th Floor

Boston, MA 02110

LIST OF DOCUMENTS: Agenda

Chair Collins called the meeting to order at 1:04 p.m. He noted that the meeting was being recorded.

Collins moved to the minutes from October 12, 2018. The Commission approved the minutes unanimously.

Collins introduced Matt Allen, ACLU-MA Field Director, presenting " Operating Under the Influence of Cannabis: Science, data, and civil liberties concerns".

- How impaired is a driver who is under the influence of cannabis?
  - Marijuana-positive drivers possess little elevated risk of motor vehicle accident compared to drug free drivers, after adjustment for potential confounding variables.
  - Marijuana combined with alcohol consumed concurrently, risk increases significantly. Inhaled cannabis's influence on performance is typically short lived, the influence of cannabis is subtle, and frequent users develop a tolerance.
  - Crash Risk Elevation is not High
  - The Effect of Inhaled Cannabis is Subtle
  - Experienced Users Become Tolerant
- How does the increase in traffic fatalities in states that have legalized cannabis compare with those who have not?
  - Fatal traffic accidents are similar between states that have legalized cannabis and those that have not.
    - "On average, MML states had lower traffic fatality rates than non-MML states. Medical marijuana laws were associated with immediate reductions in traffic fatalities in those aged 15 to 24 and 25 to 44 years, and with additional yearly gradual reductions in those aged 25 to 44 years."
  - Why does data in Washington show a spike in THC in blood of drivers who were involved in accidents in 2013 and after?
    - "Prior to 2013, the laboratory did not routinely conduct an immunoassay screen for drugs in suspected impaired driving cases where the blood alcohol concentration was >0.10 g/100 mL."
- Detection method for cannabis-caused impairment?
  - Blood tests do not offer a conclusive solution.
  - Saliva tests commonly report the detection of THC in oral fluid for 48 hours or more after smoking at sensitivities of .5ng/ mL. Some samples were positive at 72 hours, for average periods of 13-15 hours.
  - DRE
    - based on three parent studies
    - There are some methodological flaws in these studies
      - Spectrum bias, misclassification bias, and selection bias.

        - Some courts do not accept DRE testimony
- Civil Liberties Issues
    - Court issues raised, citing a number of cases.
    - Racial profiling in traffic stops
    - Issues with medical cannabis patients
        - In some subjects THC was detectable in blood for at least 7 days and oral fluid specimens were positive for THC up to 78 h after admission to the unit. Urinary THC-COOH concentrations exceeded 1000 ng/mL for some subjects 129 h after last use.
- Recommendations
    - Studies that correlate the influence of a particular drug and ability to drive a motor vehicle.
    - Studies that correlate the concentration level of a particular drug and performance on Standardized Field Sobriety Tests
    - Studies that determine the accuracy and specificity of currently used DRE evaluations using widely accepted scientific protocols.

M. Allen answered questions related to his report.

M. Maguire mentioned that on the topic of racial bias many officers will pull over an individual for observed actions, such as lane drift, without ever seeing the driver. She then asked if she understood that some drivers under the influence of cannabis may actually be better drivers because they are overcompensating. M. Allen confirmed that several studies seemed to suggest this, and not that public safety concerns should be ignored and that driving under any influence is dangerous, but that it was an interesting data point in need of more study.

M. Allen responded to concerns that many of the tests are not valid because they were simulated tests, not on the road testing by noting that there were other studies that looked at on the road studies. J. Scheft noted that M. Alegria mentioned the same issue in report.

M. Maguire mentioned a new study by the Insurance Institute for Highway Safety, which saw an increase of up to 6% in crashes in Colorado, Nevada, Oregon and Washington state compared with neighboring states that do not have recreational cannabis, with a commensurate increase in insurance rates.

S. Botch-Jones mentioned a new study that addressed this question.

Allen noted that the commission should also consider data on distracted driving, texting, and prescription drugs, not just marijuana.

M. Maguire noted that data shows that many drivers who drive impaired have multiple bad habits, not just one, which could contribute to increases in crashes. J. Carmichael agreed with this issue from the enforcement perspective. He mentioned the importance of law enforcement observations and the initial infractions, especially the importance of DRE assessments, with the lack of reliability of blood, saliva, or other tests in determining impairment. He suggested that all of the tests work together to create a more comprehensive picture than any one test alone.

Dr. Ehrlich asked if Carmichael would be in favor of collecting specimens without establishing a per se limit. Carmichael said this would be a good start.

J. Scheft said that it seemed that there was some developing consensus regarding no per se limit on the commission, but that a recommendation may be changes to implied consent laws for swabbing or other non-invasive tests at the station if an individual is brought in.

Commission members discussed methodology of studies referenced in M. Allen's presentation, and what recommendations would make sense to the legislature.

Questions and Allen's presentation concluded.

Collins offered to disseminate studies that members wish to share.

Collins invited members of the commission who have not yet presented to contact staff if interested in doing so. He mentioned that he is hoping for a presentation at an upcoming by Attorney Soriano.

Collins asked if members would be available to meet on November 16th to assign work for the legislative report. He informed the commission that staff had reserved space at the Department of Transportation building at 10 Park Plaza for the meeting.

Collins asked members to plan for meetings December 7 and 21, as well, to finalize the report. He asked that members pick up parts of the report in their area of expertise.

Following the scheduling conversation, the meeting was adjourned by unanimous vote.

Special Commission on Operating Under the Influence Meeting Minutes

November 16, 2018

Massachusetts Department of Transportation

10 Park Plaza

Boston, MA 02110

LIST OF DOCUMENTS: [Agenda]

Chair Collins called the meeting to order at 1:06 p.m. He noted that the meeting was being recorded.

Collins noted that because Dr. A. Ehrlich was calling in, all votes had to be roll call votes.

Collins moved on to the minutes. The Commission approved the minutes.

Collins moved on to the next agenda item, a discussion of the legislative report due from the Special Commission by December 31 of 2018.

Collins noted that Attorney Soriano was the sole remaining presentation, to be given to the Special Commission on December 7.

D. Solet noted that the State Police recently released their "Massachusetts Oral Fluid Drug Testing Study", which was distributed to Commission Members. Solet suggested that a part of the legislative suggestions for the report would be statutory changes that would allow oral fluid test results to be acceptable in court.

S. Jones asked if the study was done in conjunction with the recently released baseline study, which Solet noted was not from EOPSS, but from the Department of Public Health.

Solet answered questions about the study.

Collins moved to discussion of the proposed work plan for the Commission's work plan. He suggested that staff handle logistics, and other parts, but that staff lacks the subject matter expertise to answer every question required by statute.

J. Scheft suggested that the report be shorter than the proposed outline, and focus on the unanimous conclusion that no individual should consume any amount of THC and drive. He also suggested that the report contain no per se limits. He also proposed that the commission recommend legislation that would update the operating under the influence statute to be modeled after California's, to say "impaired by any substance". He also suggested creating law for implied consent for roadside oral fluid testing. He noted that there was not consensus on implied consent for DRE examinations. He also suggested changes to RMV training to address myths about cannabis use while driving.

D. Solet noted that in a 2016 Supreme Court case Birchfield vs. North Dakota, the Court ruled that implied consent for roadside blood tests is not legal without a warrant. However, a warrant is possible to obtain, as in many other states there is a process for expediting the transmission of a warrant affidavit. Massachusetts does not have that process.

M. Maguire suggested a public awareness and education campaign to accompany other parts of the report, as well as driver education.

Collins noted that it would be good to address these issues, but that some could be executive summaries, some parts could be noted in appendices. He asked that Commission members draft items that they view as priorities, and then put them before the entire commission for a vote.

Collins asked for each member to get draft recommendations and notes to staff in time for the December 7 meeting to discuss.

J. Carmichael suggested that the report also consider open container laws.

The Commission discussed Carmichael's suggestion.

Collins reiterated his request that members take the suggestions and recommendations they discussed, and send them to staff prior to the next meeting for discussion. He suggested that aside from the one report scheduled for the December meeting, the Commission spend most of the meeting time on discussing the content and structure of the report. He asked for members to send the information they wanted discussed with as much time as possible in the week of December 4th.

He then confirmed the meeting place and time for the December 7th meeting, which is the Massachusetts Gaming Commission at 1:00 p.m.

The meeting adjourned at 2:11 p.m.

Special Commission on Operating Under the Influence Meeting Minutes

December 14, 2018

Massachusetts Gaming Commission

101 Federal St, 12th Floor

Boston, MA 02110

LIST OF DOCUMENTS: Agenda

Chair Collins called the meeting to order at 1:05 p.m. He noted that the meeting was being recorded.

Collins moved on to the minutes. The Commission approved the minutes.

Collins noted that Attorney Soriano, who was the sole remaining presentation and first item on the agenda, was not in attendance, and so would move to hear from Dr. Julie Johnson and Samantha Doonan, research staff for the Cannabis Control Commission.

J. Johnson and S. Doonan gave the report on the state of the research program at the Cannabis Control Commission, and briefly answered questions.

Following the presentation, Collins again requested that members take the suggestions and recommendations they discussed, and send them to staff by Tuesday, December 18, so that staff could compile the recommendations to send back to the Commission for a vote on December 21.

He then confirmed the meeting place and time for the December 21st meeting, which is the Massachusetts Gaming Commission at 1:00 p.m.

With no other items on the agenda, Collins entertained a motion to adjourn.

The meeting adjourned at 1:54 p.m.

Special Commission on Operating Under the Influence Meeting Minutes

December 21, 2018

1:00 p.m.

Massachusetts Gaming Commission

101 Federal St., 12th Floor

Boston, MA 02110

LIST OF DOCUMENTS: Agenda

Chair Collins began the meeting at 1:06 p.m.

The Commission approved the minutes from the December 14 meeting.

Chair Collins mentioned that Stephanie Soriano was on the agenda for a presentation, but was not present for the meeting.

Chair Collins moved on to a Presentation by Mass. State Police Trooper Dillon Morris on the State Police Oral Fluid Testing Study.

Trooper Morris answered questions about the program, and concluded his presentation.

The Commission began discussion of the recommendations submitted by commission members.

Cannabis Control Commission staff consolidated all of the recommendations submitted by Special Commission members into a report that was sent to the Special Commission, and the recommendations are grouped into slides of similar subjects.

Expert Witnesses:

The Commission discussed the issue of allowing Drug Recognition Experts (DREs) to testify as expert witnesses in court. John Scheft made a motion to recommend that the legislature amend the law to allow DREs to testify as recognized experts in court.

The motion carried, 7-1.

Peter Elikann – Yes
Chief Carmichael – Yes
Matt Allen - No
Jennifer Queally – Yes
Alan Ehrlich – Yes
Sabra Botch-Jones – Yes
Mary Maguire – Yes
John Scheft - Yes

Jennifer Queally made a motion to make continuing education materials regarding Drug Recognition Experts available to the judges conferences and the state judiciary as training.

The motion passed unanimously.

Penalties:

The commission discussed the issue of assigning the same civil penalty for Open Container Violation Laws under Chapter 94C for marijuana as alcohol. The Commission decided not to vote on that issue until the following meeting.

Funding and Training

The Commission voted to recommend that the state should train a minimum of 351 Drug Recognition Experts, as well as several DREs for the Massachusetts State Police. Jennifer Queally made the motion.

The motion carried, 7-0.

Peter Elikann – Yes
Chief Carmichael – Yes
Jennifer Queally – Yes
Alan Ehrlich – Yes
Sabra Botch-Jones – Yes
Mary Maguire – Yes
John Scheft - Yes

Advanced Roadside Impaired Driving Enforcement

Jennifer Queally made the motion, seconded by Sabra Botch-Jones, to create a statewide requirement that all officers be ARIDE certified, with funds for training to come from the marijuana regulation fund.

The motion carried, 7-1

Peter Elikann – Yes
Chief Carmichael – Yes
Matt Allen - No
Jennifer Queally – Yes
Alan Ehrlich – Yes
Sabra Botch-Jones – Yes
Mary Maguire – Yes
John Scheft - Yes

Implied Consent

John Scheft moved to recommend that the state establish implied consent requirements for a DRE assessment as is currently done for breath and blood testing. Mary Maguire seconded.

The motion carried, 7-1.

Peter Elikann – Yes
Chief Carmichael – Yes
Matt Allen - No
Jennifer Queally – Yes
Alan Ehrlich – Yes
Sabra Botch-Jones – Yes
Mary Maguire – Yes
John Scheft - Yes

The Commission discussed a meeting for the week of December 24. The Commission agreed to meet Friday, December 28 at noon, to complete the voting process for the remaining recommendations.

The Commission adjourned with a unanimous vote at 4:17 p.m.

Special Commission on Operating Under the Influence: Recorded Votes

December 28, 2018

1 Ashburton

21st Floor

Boston, MA 02113

Members in attendance:

Shawn Collins, Chair

Undersecretary Jennifer Queally

Matt Allen

Chief John Carmichael

John Scheft

Sabra Botch Jones

Dr. Alan Ehrlich

Mary Maguire

Peter Elikann

Judge Robert Kane

Votes taken:

1. Oral Fluid Test Study
   Motion carried unanimously
2. DRE Implied Consent
   Motion carried, 9 in favor with Matt Allen voting "No."
3. Open Container
   Motion carried unanimously
4. Horizontal Gaze Nystagmus
   Motion carried, 8 in favor with Matt Allen and Peter Elikann voting "No."
5. Electronic Warrant
   Motion carried, 9 in favor with Matt Allen voting "No."
6. Blood
   Motion carried unanimously
7. Public Awareness
   Motion carried unanimously
8. Driver Education
   Motion carried unanimously
9. Materials

Motion carried unanimously

10. THC Impairment
    Motion carried unanimously
11. Judicial Facts
    Motion carried unanimously
12. California OUI
    Motion carried unanimously
13. Make Explicit that Drug Concentration Evidence is not a Precondition to Admission of Evidence of the Presence of an Impairing Substance
    Motion carried unanimously
14. Public Way
    Motion carried, 9 in favor with Matt Allen voting "Present."
15. Window
    Motion carried, 9 in favor with Matt Allen voting "No."

Appendix C: Presentations to Members of the Special Commission

John Sofis Scheft, Esq.
Law Enforcement Dimensions, LLC

Policing with Perspective

To: Special Commission Members

From: John Scheft

RE: Simple amendment to G.L. c. 90, § 25

Date: December 20, 2018

Here's another last minute idea for a simple but important legislative step. Amend G.L. c. 90, § 25 so that it requires motorists to roll down their window fully when stopped by police.

Basically, 90, § 25 deals with traffic stops and requires that motorists provide their license and registration to police officers.[1] The statute is silent on whether motorists must roll down their window completely to facilitate officers receiving the requested paperwork and communicating with drivers. Absent a definitive standard, internet advisors often encourage motorists to press the issue with police.[2] Yet, this initial interaction is often an important part of learning whether a driver is impaired.

While the Appeals Court has addressed the issue in an "unpublished opinion" (see copy on next page), there should be more definitive direction to all motorists in the statute that sets forth the basic steps of compliance for a citizen who is subject to a police motor vehicle stop. The legislature would simply have to add to 90, § 25, after the phrase, "when requested by a police officer," the phrase, "to fully lower the window on the driver's side of the vehicle stopped."

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[1] The exact language of 90, § 25 is: "Any person who, while operating or in charge of a motor vehicle, shall refuse, when requested by a police officer, to give his name and address or the name and address of the owner of such motor vehicle, or who shall give a false name or address, or who shall refuse or neglect to stop when signalled to stop by any police officer who is in uniform or who displays his badge conspicuously on the outside of his outer coat or garment, or who refuses, on demand of such officer, to produce his license to operate such vehicle or his certificate of registration, or to permit such officer to take the license or certificate in hand for the purpose of examination, or who refuses, on demand of such officer, to sign his name in the presence of such officer, and any person who on the demand of an officer of the police or other officer mentioned in section twenty-nine or authorized by the registrar, without a reasonable excuse fails to deliver his license to operate motor vehicles or the certificate of registration of any motor vehicle operated or owned by him or the number plates furnished by the registrar for said motor vehicle, or who refuses or neglects to produce his license when requested by a court or trial justice, shall be punished by a fine of one hundred dollars."

[2] See, e.g., https://www.avvo.com/legal-answers/do-i-have-a-right-to-not-roll-down-my-window-if-i--2274803.html; https://forum.officer.com/forum/public-forums/ask-a-cop/145867-only-rolling-down-window-2-inches; https://www.riskology.co/traffic-stop/.

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No. 11–P–1777.
Appeals Court of Massachusetts.

Commonwealth v. O'Brien

983 N.E.2d 749 (Mass. App. Ct. 2013)

Decided February 28th, 2013

By the Court (GREEN, GRAHAM & SULLIVAN, JJ.).

MEMORANDUM AND ORDER PURSUANT TO RULE 1:28

After observing the defendant's vehicle repeatedly cross over the rumble strip on Interstate Highway 91, a State trooper pulled the car over on the basis of a marked lane violation. He asked the defendant, whose car window was only partially open, to roll down her window. The defendant concedes the initial traffic stop was lawful, see *Commonwealth v. Santana,* 420 Mass. 205, 207 (1995), but now claims that the request to roll down her window constituted an unlawful search and seizure in violation of art. 14 of the Massachusetts Declaration of Rights and the Fourth Amendment to the United States Constitution. On that basis, she challenges her conviction of operating a motor vehicle while under the influence of alcohol. G.L.c. 90, § 24(1)(*a*)(1).

The request was minimally intrusive and reasonably related to a threshold inquiry in which the officer could have been expected to explain the reason for the stop. See *Commonwealth v. Garden,* 451 Mass. 43, 46 (2008). The officer had to obtain the license and registration before issuing a citation, and his request to do so without dealing with the barrier of a partially closed window was likewise "minimally intrusive." *Commonwealth v. Obiora,* 83 Mass.App.Ct. 55, 57 (2013). The defendant's citation of cases involving a physical intrusion upon the person or property of the defendant during a traffic stop, see, e.g., *Commonwealth v. Gonsalves,* 429 Mass. 658, 663–665 (1999), is therefore inapposite. There is no reasonable expectation of privacy in the odor of alcohol on her breath, and the defendant does not so claim. See *Commonwealth v. Feyenord,* 445 Mass. 72, 82 (2005).

Judgment affirmed.

Introduction to Weakest in the Nation

Previously published as: 2018 DUI/DUID Interim Committee Briefing Book

In 2017, Colorado passed HB17-1315 which required the State to collect, analyze and annually publish Driving Under the Influence (DUI) and Driving Under the Influence of Drugs (DUID) data from the Colorado's courts, laboratories and state agencies. This will be the first large-scale study to consider substances *causing DUI charges*, not just those *involved with fatalities* as most studies have done. Colorado will know which drugs and drug combinations are the most prevalent in DUIs, and will no longer have to guess how the conviction rate differs between DUI-alcohol cases and DUID cases.

In 2018, a bi-partisan group of 36 legislators supported a proposal that the Legislative Council convene a two-day study committee to review the HB17-1315 data and to consider appropriate legislation. The Legislative Council denied that request.

This book was originally produced as a briefing book for use by that committee during its deliberations. It incorporates a summary of scientific studies published since 2013, when Colorado's DUI law was revised to include a 5 ng/ml permissible inference level for marijuana's THC.

This re-titled book is now being published to enlist support of legislators to consider such legislation.

Weakest in the Nation:

Colorado's DUID laws are the weakest
in the nation; why and how to fix that

Ed Wood

DUID Victim Voices

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Foreword

Ed Wood has created a uniquely valuable Briefing Book for the 2018 DUI/DUID Interim Committee.

Drug-impaired driving is a serious highway safety threat on the scale of the well-recognized threat posed by alcohol-impaired driving. Despite the magnitude of the problem, the response to drug-impaired driving remains woefully inadequate. The controversies over marijuana-impaired driving not only dominate the drugged driving issue but they bring it to a screeching stop. Drug-impaired driving is much bigger than marijuana-impaired driving. Moreover, the substance-impaired driving issue is no longer dominated by the use of single drugs (e.g., alcohol or marijuana) but by the simultaneous use of multiple impairing psychoactive drugs, both legal and illegal. These largely overlooked facts are made clear in this Briefing Book.

Today Colorado is ground zero for the legalization of marijuana for the United States and also for the world. Colorado is the world's laboratory for managing the negative impacts on the roads from all drugs, not just marijuana. It is essential that the full capabilities of this great state be brought to bear to understand and to manage the problem of drug-impaired driving.

I write this as a proud 1954 graduate of East High School in the Mile High City where the girl I double-dated with in my Junior and Senior years was Madeleine Albright and where one of the graduates a year ahead of me at East was Norman Augustine. These are two of the greatest leaders to come out of Denver.

I also write this as the first director of the National Institute on Drug Abuse (NIDA) where one of the first topics taken up by the organization after its founding in 1973 was drug-impaired driving. I also served as the second White House drug chief under Presidents Nixon and Ford. The drug-impaired driving has been recognized and researched, but not adequately addressed, for 50 years.

With this long national, and even global, perspective, I assure you that Ed Wood is without peer when it comes to drug-impaired driving. He has devoted himself to reducing drug-impaired driving to honor his adult son who was killed by a drug-impaired driver who received a virtual slap on the wrist for this crime. Ed is not just passionate, although he is that. He has studied the issue for a decade. He knows the leaders in the field and finds ways to engage them in this vital public safety initiative. I am proud he includes me in his remarkable list of committed collaborators.

Use this Briefing Book. Treasure it. Most importantly, wrestle the challenge of drug-impaired driving to the ground. Lead the country. Our nation needs strong leadership on drugged driving, including but not limited to marijuana-impaired driving, from Colorado. The problem is complex. There is no silver bullet. The precedent of the 0.08 g/dL blood alcohol concentration (BAC) per se limit for alcohol is unavailable for other drugs including marijuana. This is not due to lack of research; this exact issue has been researched for four decades. Marijuana is not the outlier; alcohol is. There are many effective steps to be taken to better assess the problem of drug-impaired driving and to significantly reduce it.

This wonderful Briefing Book is your guide for your much-needed leadership.

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Preface

The National Highway Traffic Safety Administration (NHTSA) convened a "Call to Action"[i] March 15, 2018 to begin a national dialog on how to address the nation's growing Driving Under the Influence of Drugs (DUID) problem. This, following the publication of "Drug-Impaired Driving: A Guide to What States Can Do" by the Governors Highway Safety Association (GHSA)[ii] and the recent efforts of organizations like the Institute for Behavior and Health, the Heritage Foundation, SAM, DUID Victim Voices and We Save Lives suggests that the issue of DUID may be approaching a tipping point.

This Briefing Book was created to further that dialog.

Part One contains background scientific information to understand drug-impaired driving in the context of overall highway safety, as well as alcohol-impaired driving and distracted driving. It summarizes key research, and separates DUID fact from fiction. Two chapters focus on marijuana-impairment which is one of many causes of DUID. DUI is not just about alcohol and DUID is not just about marijuana. Claims that marijuana does not impair driving are debunked.

Part Two provides legal references. It contains current relevant Colorado statutes that deal with DUID and provides some state-by-state statute comparisons. Finally, it summarizes national model policy and statute recommendations from US and European agencies and organizations.

Part Three provides new data for consideration by the committee. Data published by Colorado's Division of Criminal Justice pursuant to HB 17-1315 are not included since that information is presented separately as a core component of the committee's work.

Of particular importance, Part Three presents an annotated bibliography of 73 relevant DUID reports and scientific publications published since 2013. More research is welcome, but it is even more important to learn from the research that already has been done, which is summarized here.

Part Four proposes recommendations for consideration, based upon the national model recommendations in Part Two as well as an analysis of Colorado's unique conditions.

Throughout this manual, the term THC refers *only* to Delta 9-tetrahydrocannabinol, the psychoactive cannabinoid in marijuana.

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[i] https://www.nhtsa.gov/events/drug-impaired-driving-call-action
[ii] https://www.ghsa.org/sites/default/files/2016-11/Drug-Impaired Driving- A Guide For What States Can Do-Interactive.pdf

Executive summary

Two facets of the Driving Under the Influence of Drugs (DUID) problem are of concern. First, DUID drivers kill and maim innocent victims. Second, DUID victims often fail to see the same kind of justice that is delivered to drunk driving victims because laws designed to deal with alcohol impairment do not work well for drug impairment.

Driving Under the Influence (DUI) is not just about alcohol, and DUID is not just about marijuana. Whereas in years past, alcohol was the only impairing substance commonly found in drivers, today's forensic laboratories report that polydrug impairment is more common than impairment by either alcohol alone or marijuana alone. Although alcohol and marijuana are the most commonly found drugs in drivers involved in fatal crashes, they are very frequently found in combination, often with narcotics, depressants, stimulants, and other drugs.

Public knowledge about drunk driving is widespread but frequently wrong. Knowledge about drugged driving is far less common and even more commonly wrong. The public in general fails to understand the DUI arrest process and the difference between DUI and DUI *per se*.

Until the last few years, driving has become increasingly safer. The average person will be involved in a fatal crash only about once every 85 lifetimes. So when drivers are warned that an activity like drinking alcohol, using drugs or texting and driving can increase the risk of a fatal crash, drivers can and do ignore such warnings. And they usually get away with it. This explains why so many messages to avoid drunk, drugged or distracted driving are ineffective.

Marijuana-impaired driving is of particular concern not because of its inherent danger, but because of its increasing prevalence and a commonly held false belief that stoned driving is not dangerous. Marijuana-impaired driving is less deadly than drunk driving, just as a .22 caliber bullet is less deadly than a .45 caliber bullet. But all four can and do kill.

Blood tests or breath tests have been used successfully to assess alcohol impairment for decades. But alcohol is the *only* drug for which there is a strong correlation between impairment and blood or breath concentrations. For marijuana's impairing delta 9-tetrahydrocannabinol (THC), virtually all scientific research has demonstrated that even though higher doses of THC impair more than lower doses of THC, there is absolutely no correlation between THC impairment and blood levels of THC.

Individuals can develop a tolerance to some of the impairing effects of drugs, including alcohol, marijuana and opioids. But tolerance to some of a drug's impairing effects does not make the individual tolerant to all impairing effects. Addicts and other heavy users of drugs can be just as impaired as novice users.

Colorado's DUID laws are considered the weakest in the nation for several reasons:

1. The 5 nanogram per milliliter permissible inference level for marijuana's THC ensures that most THC-impaired drivers who test below 5 ng/ml will not be convicted of DUI.
2. The 5 ng/ml permissible inference level does not guarantee that THC-impaired drivers who test above 5 ng/ml will be convicted of DUI.
3. Colorado relies upon a very stringent statutory definition of DUI that is difficult to prove in court: "the person is substantially incapable" of safe driving.
4. Colorado has a lower offense of Driving While Ability Impaired (DWAI): "affects the person to the slightest degree" similar to the statutory DUI definition of some other states. But although vehicular homicide due to DUI is a Class 3 felony, vehicular homicide due to DWAI is not even a misdemeanor.
5. Colorado tests a minority of DUI suspects and drivers involved in fatal crashes for drug presence. Therefore, the prevalence of drug impaired driving is not well understood.
6. Colorado provides a statutory presumption of innocence for drivers testing below a Blood Alcohol Concentration (BAC) of 0.05, which fails to recognize that a non-impairing dose of alcohol combined with a non-impairing dose of THC can impair a driver.

The following statutory changes are recommended to improve Colorado's DUID laws:

Transformative changes

1. Change the THC permissible inference law to a Tandem *per se* law. [See Chapter 12.]
2. Require evidentiary drug testing of any driver who tests positive for drugs on a preliminary drug test; and evidentiary drug testing of all drivers involved in fatal crashes.
3. Implement oral fluid testing: roadside non-quantitative preliminary oral fluid testing if the officer has reasonable grounds to believe that the driver may be impaired by drugs; evidentiary laboratory oral fluid testing as an alternative to blood testing to prove the presence of an impairing substance.

Improvements

1. Redefine DUI for drugs similar to Vermont's recent definition.
2. Establish zero tolerance for all psychotropic drugs in drivers under the age of 21.
3. Reclassify penalties and misdemeanors to criminalize vehicular homicide or assault due to DWAI; make vehicular homicide or assault due to careless driving a felony.
4. Impose the same requirements and sanctions for drug testing that currently apply to alcohol testing.
5. Eliminate the statutory presumption of innocence for a BAC below .05 if psychotropic drugs in addition to alcohol are present.
6. Enhance penalties for polydrug impairment.
7. Eliminate alcohol sanctions for drug impairment convictions.
8. Implement electronic warrants to reduce delays in taking blood samples.
9. Adopt National Safety Council forensic testing recommendations.
10. Include officer-collected evidence from the scene of arrest in the Division of Criminal Justice reports.

The above recommendations are offered as a menu, not as a package, since the effects of some recommendations overlap.

Part One – Background

Scope of the problem

Impaired driving – the problem in perspective

Marijuana-impaired driving facts and myths

Understanding contrary reports

We found SUBSTANTIAL evidence that recent marijuana use by a driver increases their risk of a motor vehicle crash.

Colorado Department of Public Health and Environment's "Monitoring Health Concerns Related to Marijuana," 2016

69% of Colorado marijuana users have driven under the influence of marijuana in the past year. 27% of users do so at least 5 times per week.

Survey of 7,698 marijuana users as of April 9, 2018 from Colorado Department of Transportation's Cannabis Conversation program

Scientific evidence on the association between cannabis use and driving impairment contrasts with public attitudes toward driving under the influence of cannabis. Regular cannabis users often admit to driving under the influence of cannabis and wrongfully believe that cannabis does not affect their driving performance or that they can compensate for cannabis-associated impairment.[1]

Johannes G. Ramaekers, PhD

Chapter 1
Introduction

Two facets of the DUID problem

Two different DUID problems concern us:

1. DUID drivers kill and maim innocent victims. Information in Chapters 2 and 9 supports this claim. How can we prevent this tragedy? Chapter 7 provides many suggestions.
2. DUID victims often fail to see the same kind of justice that is delivered to DUI-alcohol victims because laws designed to deal with alcohol impairment do not work well for drug impairment. Information in Chapters 3, 6, 8 and 10 supports this claim. How can we ensure parity of justice for DUID victims? Chapters 7, 11 and 12 provide suggestions.

Driving Under the Influence of Drugs (DUID) is a widely known yet poorly understood problem. Unfortunately, some firmly-held opinions about the subject are contrary to fact and can hinder rational discussion and resolution of the problem. So in this introductory chapter we will briefly explain the problem and try to clear up common misunderstandings.

DUID is not just about marijuana

Drugs that can impair safe driving ability are in the following four categories: [2]

- Illegal drugs – e.g. heroin, cocaine, methamphetamine
- Prescription drugs – e.g. opioids, benzodiazepines (may be used legally or illegally)
- Legal non-medicinal drugs – e.g. alcohol, marijuana in Colorado
- Over the counter medications – e.g. antihistamines, anti-diarrhea drugs, anti-emetics

The National Highway Traffic Safety Administration (NHTSA) has classified nearly 1,000 impairing drugs into nine categories including the following that are the prevalent causes of impaired driving in the U.S[3].

- Narcotics – these include the naturally-derived opiates like heroin and morphine as well as synthetic opioids like Fentanyl, Oxycontin® (Oxycodone), and Vicodin® (Hydrocodone).
- Depressants – older depressants like barbiturates have been largely replaced by a wide range of benzodiazepines such as Valium® (Diazepam) and Ativan® (Lorazepam). Sleep aides like Ambien® (Zolpidem) are also included in this category.
- Stimulants – the most commonly abused stimulants are methamphetamine and cocaine.
- Cannabinoids – this is the second most common drug (after alcohol) found in both drivers arrested for DUI as well as drivers in fatal crashes.

Other less commonly cited categories are inhalants, PCP, anabolic steroids and hallucinogens.

Table 1 shows the prevalence of the various NHTSA categories of drugs, as well as the estimate of the Odds Ratios (ORs) of those categories. The OR is the statistical likelihood that an outcome (e.g. crash, fatality, serious injury) will occur given a particular drug exposure, compared to the odds of the outcome occurring in the absence of that exposure. An OR of 15 for fatal crashes for a driver with a BAC of 0.10, for example, means that a driver with a BAC of 0.10 has 15 times the likelihood of being involved in a fatal crash than an identical sober driver at the same time, place and under the same conditions. An OR of 1.5 would mean a 50% greater chance of being involved in a fatal crash. The data in Table 1 were derived from NHTSA's Fatality Analysis Reporting System (FARS) which has limitations described later, but it is the best we have for this kind of analysis.

Table 1[4]

Prevalence of drugs detected and crude Odds Ratios and 95% Confidence Intervals of fatal crash involvement according to drug category, in the continental United States, selected time periods on Fridays and Saturdays, July 20 through December 1, 2007.

Drug Category	% of Cases (n=737)	% of Controls (n=7719)	Crude OR[a]	95% CI
Marijuana	9.8	5.6	1.83	1.39, 2.39
Narcotics	4.8	1.6	3.03	2.00, 4.48
Stimulants	9.4	2.8	3.57	2.63, 4.76
Depressants	5.2	1.1	4.83	3.18, 7.21
Polydrug[b]	7.1	2.2	3.41	2.43, 4.73

OR = Odds Ratio; CI = Confidence Interval;
[a] Drivers who tested negative for the specific drug category were used as the reference group;
[b] Two or more non-alcohol drugs.

Guohua Li. Accid Anal Prev. 2013

Public beliefs

Generally, the public is very aware of the dangers of drunk driving, but somewhat less so about the dangers of driving under the influence of other drugs.

In September 2013, 78% of surveyed Coloradans believed the state's DUI laws covered impairment by marijuana. 70% of respondents agreed they could *not* drive safely after using certain prescription medications and 85% believed they could *not* drive safely under the influence of marijuana.[5]

However, most (55%) of Colorado's marijuana users felt they *could* drive safely under the influence of marijuana. The same thing was found in a 2016 survey.[6] A 2018 survey of recreational marijuana users revealed that 11% believe marijuana makes them a better driver.[7] This belief is more prevalent in youth than in adults.[8] There is clearly a great disconnect between the safety beliefs of marijuana users compared with other Coloradans, and, as we shall see in Chapter 3, between the safety beliefs of marijuana users compared with scientific studies.

Legislators should address both impairment from drugs as well as this disconnect in beliefs about the dangers of marijuana-impaired driving. Educational programs focusing on safety is of greater importance than programs that focus on laws. Knowledge of the safety implications of marijuana can reduce DUID, whereas improving knowledge of DUID laws is less effective.[9]

Although good information on the issue of drugged driving is available from the scientific literature and NHTSA's Fatality Analysis Reporting System (FARS), most knowledge fueling public beliefs comes predigested by the media and reports from organizations like the Marijuana Policy Project (MPP), the Drug Policy Alliance (DPA), and the National Organization to Reform Marijuana Laws (NORML). Often, these sources have served to confuse as much as they have to illuminate as we will discuss further in Chapters 3 and 4.

How DUIs are investigated

A common belief is that a police officer uses a breathalyzer at the roadside to prove that a driver is impaired by alcohol. This myth is created by not understanding the difference between DUI and DUI *per se*.

DUI	Colorado Revised Statute (CRS) 42-4-1301 (1)(a) A person who drives a motor vehicle or vehicle under the influence of alcohol or one or more drugs, or a combination of both alcohol and one or more drugs, commits driving under the influence.
DUI *per se*	CRS 42-4-1301 (2)(a) A person who drives a motor vehicle or vehicle when the person's BAC is 0.08 or more at the time of driving or within two hours after driving commits DUI *per se*.

To prove that a driver is guilty of DUI, the court must prove that the driver was substantially incapable of safely driving the vehicle. Refer to C.R.S. 42-4-1301 (1) (f). To prove that a driver is guilty of DUI *per se,* the court must prove that the driver had a blood alcohol content (BAC) of .08 g/dL or higher. Legal sanctions for DUI and DUI *per se* are identical. Drivers with a BAC greater than .08 are routinely charged with both DUI and DUI *per se.* So it should come as no surprise that many people view DUI and DUI *per se* interchangeably.

But the timing and the process for gathering evidence for the two charges is quite different. Police test for drug impairment just as they do for alcohol, based on driving behavior and roadside impairment assessments. Assessments are done by observations and by asking questions of the suspect. Additionally all officers are trained to perform Standardized Field Sobriety Tests (SFSTs) which enable them to document evidence of alcohol impairment based upon observations. A growing number officers receive additional training called Advanced

Roadside Impaired Driving Enforcement (ARIDE). An ARIDE-trained officer can more readily identify a driver impaired by drugs than an officer who has received training only in SFSTs. A very small number of officers (less than 2% in Colorado) are trained as Drug Recognition Experts (DREs). DREs are trained to not only identify drug impaired drivers but to determine the class of drugs most likely to be causing the observed impairment.

An officer may use a breathalyzer at the roadside to guide his alcohol impairment assessment process and to confirm that there is probable cause to subject the driver to toxicology testing. A breathalyzer is considered to be a preliminary test and results are not admissible at trial.

An evidentiary breath test (EBT) may be performed as well, but that is typically done at a police station as an alternative to a blood test. EBTs are performed after an arrest has been made.

Assessments results are immediately available to an officer and are used to determine if a DUI arrest should be made. Blood toxicology results may become available days, weeks, and sometimes months after the arrest is made. Toxicology tests are used to confirm the cause of the observed impairment, to support a court case confirming DUI, and are also used to prove DUI *per se.* Toxicology results do not determine if someone is impaired or should be arrested.

Legal limits

A BAC of .08 is commonly but inaccurately referred to as a DUI legal limit. It is indeed the lower limit that defines a DUI *per se* but a driver can be convicted of DUI even if the BAC is below .08 if there is sufficient evidence.

A puzzling fact about marijuana is that, unlike alcohol, there is no correlation between forensically-determined THC levels in blood and levels of impairment, giving rise to statements such as:

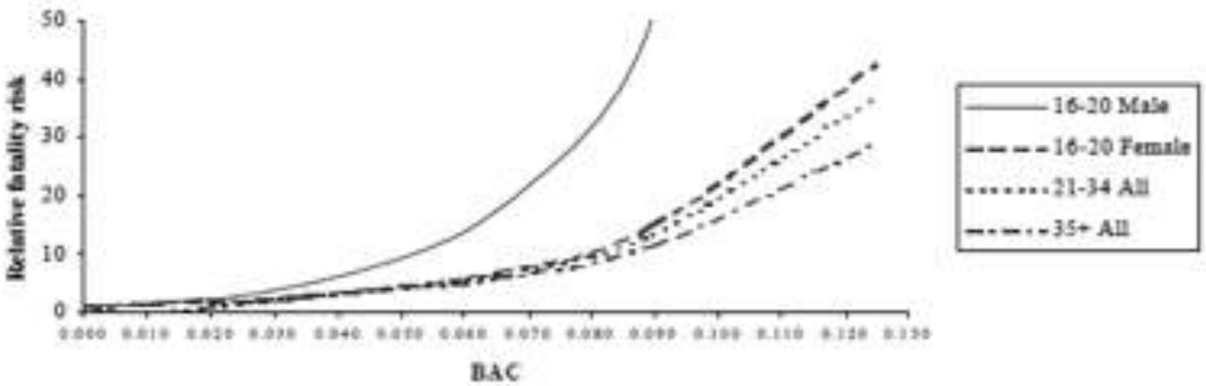
- Why can't science find a BAC .08 equivalent for marijuana?
- I'll vote for a THC *per se* limit when science tells us what it should be.

The reason "science" can't find a BAC .08 equivalent for marijuana is not because we need more research. We've done the research, and we know that such a limit does not exist for many biological and chemical reasons. The American Automobile Association Research Foundation listed 20 ways that marijuana differs from alcohol,[10] including the aforementioned biological and chemical differences. With such vast differences between marijuana and alcohol, it should come as no surprise that the BAC *per se* approach used successfully for alcohol doesn't work for marijuana.

"Science" didn't determine the BAC .08 limit in 49 of the US states (or Utah's BAC .05 limit). Politicians made that determination, based upon scientific facts that do not exist for marijuana. Proof that politicians, not science created the .08 level is the fact that different countries and states have different BAC *per se* levels, ranging from 0.02 to .08, all using the same scientific input.

There is no correlation between forensically-determined THC levels in blood and levels of impairment, but that is not unique to marijuana. Alcohol is the <u>only</u> drug for which there is a well-defined correlation between blood levels of alcohol and levels of impairment. This relationship was documented by Robert Borkenstein in 1964 and has since been replicated worldwide with similar, although not identical results. See Figure 1 for an example.[11]

Figure 1 Relative Risk for drinking drivers by age and sex in single vehicle fatal crashes



NHTSA DOT 809 050

Because of the high correlation between BAC and impairment, we can reliably infer alcohol impairment by understanding blood alcohol levels even though blood is never impaired by alcohol. Only the brain is impaired by alcohol.

Inference of alcohol impairment can be made from BAC because alcohol is a very small water-soluble molecule that rapidly establishes a concentration equilibrium everywhere in the body that is highly perfused with blood. Therefore, what's in the blood is in the brain, and vice versa. As the level of alcohol in the brain increases, the level of impairment increases. And by measuring alcohol level in blood, we have a very good idea of what is in the brain and how impaired someone is.

That doesn't work for most drugs, especially THC. Drugs other than alcohol are very large molecules and many of them are poorly soluble in water. THC, for example is highly fat soluble so only very small quantities can remain dissolved or suspended in blood. For smoked or vaped marijuana, THC blood levels rise very rapidly for several minutes. Then the THC is quickly soaked up by the brain and other fatty tissues that are highly perfused with blood. The redistribution from blood to brain happens so quickly that the maximum level of THC in the blood can drop an average of 73% within the first 25 minutes after beginning to smoke a joint.[12]

THC remains in the brain at high levels even when it cannot be detected in blood due to this rapid redistribution. Mura showed[13] by testing blood and brain tissue of 12 cadavers that the level of THC in the brain was higher than the level of THC in the blood of 100% of his subjects. In some cases, THC was present in the brain, even though none could be detected in the blood.

Cannabinoids

Marijuana contain dozens of types of molecules in the family of cannabinoids, estimated to be at least 60, perhaps more than 100. Some are psychoactive, some have other medicinal effects with no psychoactive effects, and still others have no known activity When metabolized by the body, some of these cannabinoids turn into other molecules called metabolites that retain their cannabinoid character.

Cannabinoids of interest include:

- THC – a.k.a delta 9-THC or delta 9-tetrahydrocannabinol. This is produced from THCA in the marijuana flower by heating or drying. It is psychoactive.
- Hydroxy-THC – a.k.a. 11-hydroxy-THC. This is the primary metabolic by-product of THC. It is psychoactive with a very short half-life.
- Carboxy-THC – a.k.a. 11 nor 9-carboxy THC or THC-COOH. This is the water soluble, non-psychoactive metabolic by-product of hydroxy-THC.
- Cannabinol – a.k.a CBN. A mildly psychoactive compound that has a sedative effect, found in trace amounts in most marijuana preparations.
- Cannabidiol – a.k.a CBD. A medically active, non-psychoactive component of marijuana.
- Cannabigerol – a.k.a CBG. A marker of recent THC use.

Some journalists and even some laboratories refer to carboxy-THC as THC. This has created a great deal of confusion and misunderstanding. Since carboxy-THC is an inactive metabolite of THC, many people believe that all metabolites are inactive. That is not the case since hydroxy-THC is highly psychoactive.

Chapter 2
Impaired Driving – The problem in perspective

Public responses to drunk vs drugged driving

George Smith was the first person known to be arrested for drunk driving in London in 1897. New Jersey outlawed drunk driving in 1906 but for decades it remained difficult to prove that alcohol was the cause of a crash. Defense attorneys were successful with the claim, "But it was an accident. It could have happened to anyone. The Government can't prove that alcohol caused my client's accident."

The term *accident* for a crash caused by impaired drivers is still used by many people today. The proper term for such a crash is a *crime*, not an *accident*. Prior to proof that crime has been committed, the more neutral term *crash,* rather than *accident* should be used.

During the first half of the 20th century all states adopted one form or another of drugged driving laws, frequently adopting a "legal limit" of 0.15 grams per 100 ml of blood (also referred to as .15 gm/dL or more simply, BAC 0.15). Over the next several decades other states adopted similar laws. Drunk driving cases continued to climb. Margaret Mitchell, the author of *Gone with the Wind* was killed by a drunk driver in 1949 which raised public awareness of the growing problem, but the public outrage was fleeting.

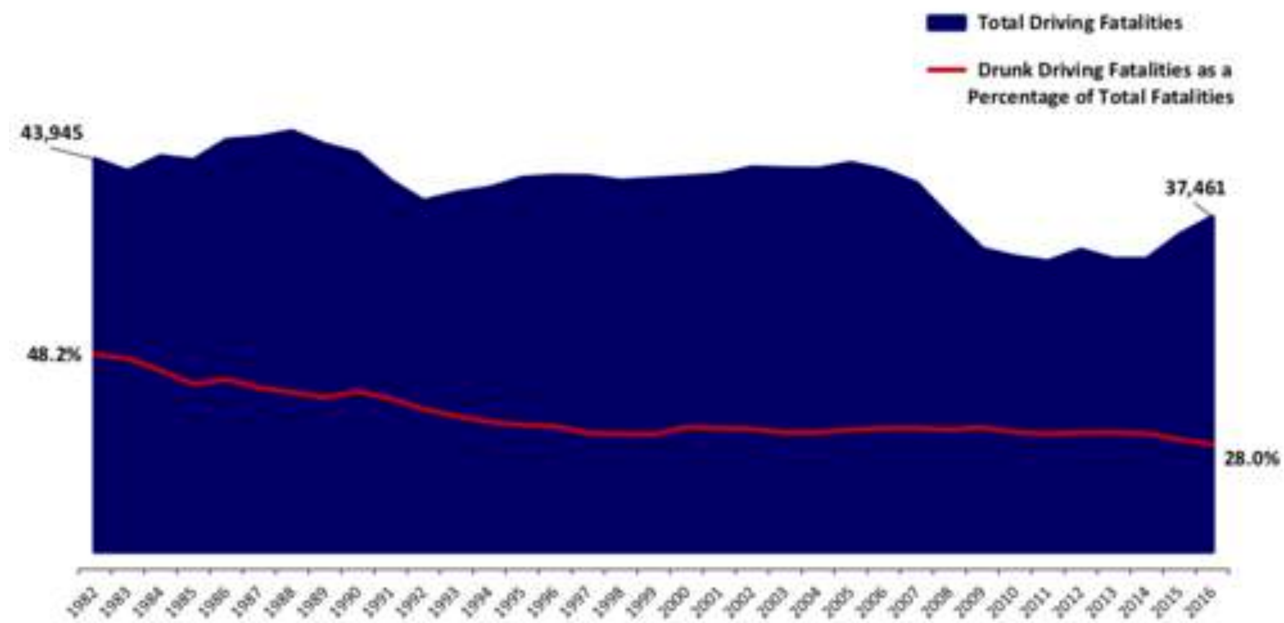
In 1968, the US Department of Transportation issued a report saying that nearly one-half of all traffic fatalities were caused by alcohol-impaired drivers. The public reaction was muted. By the 1960s, over 25,000 people were dying as a result of drunk driving. By the 1970s the proportion of traffic fatalities due to alcohol was reported to be 60%.

Cari Lightner was 13 years old in 1980 when she was killed by a drunk driver who had three prior convictions for drunk driving, yet was still driving with a valid California license. Cari's mother Candace became the tipping point that forced the United States to address drunk driving as the serious problem that it was and remains today.

Candace Lightner formed Mothers Against Drunk Driving (MADD) and tirelessly campaigned to change the way the nation considered drunk driving and dealt with its consequences. By sheer force of personality, commitment, anger and compassion, Lightner and the MADD movement turned the tide. The minimum drinking age of 21 was established. Zero tolerance for any alcohol in drivers under the age of 21 became the norm. Administrative License Revocations for drunk drivers were put in place. The advertising slogan, "Friends don't let friends drive drunk" was launched. By 1997 all states had finally adopted DUI *per se* limits no higher than BAC 0.10.

The results of the national efforts were impressive. Traffic deaths plateaued and the proportion due to drunk drivers declined. The DUI decline continued until the "Friends don't let friends drive drunk" campaign ceased in 1999, and has hovered around the 30% range since then. See Figure 2[14].

Figure 2 Total traffic fatalities and DUI fatalities 1982 - 2016



2016 NHTSA FARS

Contrast this national response with the responses to the recent increase in non-alcohol related deadly traffic crashes. There has been a 14% spike in traffic deaths in the last two years. Why the recent increase? It's not driven by alcohol, which is up 'only' 9%, or even speeding, which is up 6%. Is it DUID? Distracted driving? Probably, but we don't adequately measure and report those causes.

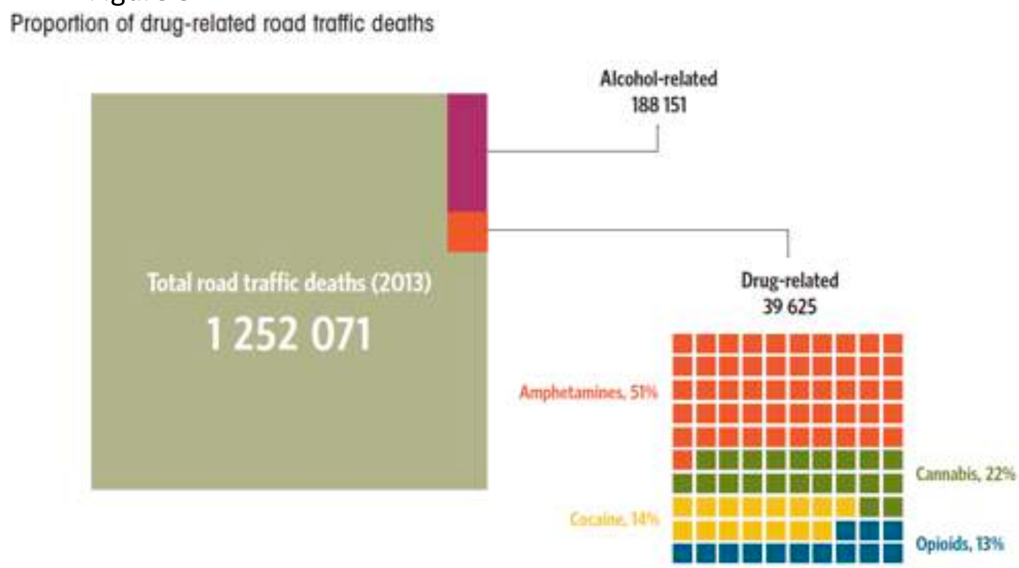
Assuming that DUID is a major component of the increase in traffic deaths, we're not taking the common sense actions as a nation that we took for drunk driving. Instead, we're legalizing another mind impairing drug (marijuana), requiring warrants for many blood draws in cases of DUI, and protecting stoned drivers by passing 5 ng/ml (nanograms per milliliter) THC *per se* laws. There are also widespread efforts to deny the problem exists. See examples of this in Chapter 4.

Drugged, drunk and distracted driving – combined effects

It is easy and quite common to attribute a tragedy to a single cause, rather than to several contributing causes. Doing so simplifies the message so that it can fit on a bumper sticker, and to help rally support. But doing so can distort reality.

See Figure 3,[15] for an example of this distortion, published by the World Health Organization.

Figure 3



A Policy Brief: Drug use and road safety. WHO. 2016

There is nowhere in Figure 3 where drivers impaired by multiple drugs or by alcohol combined with drugs can be recorded even though polydrug impairment has been shown to be more common than either alcohol impairment or impairment by any single drug.[16]

Part of the problem is that it is easy to prove that a driver is impaired by alcohol and we often don't even try to prove that a driver is impaired by drugs. Colorado has a single citation number for DUI irrespective of cause; alcohol, drugs, or a combination of both. As a result, if there is sufficient evidence of alcohol impairment to convict, there is no incentive for law enforcement to spend the resources to prove that the driver was also impaired by drugs. It's no wonder that we don't even bother to test adequately for DUID as quantified in Chapter 8.

Distracted driving is another well-known but poorly understood problem. NHTSA estimated that in 2015 there were 3,477 deaths due to distracted driving, 476 of which were due to use of cellphones. These data come from FARS but NHTSA acknowledges that FARS only captures a portion of distracted driving incidents. Most states don't have space on their crash reports to note if a driver was found to have been texting during a crash, so none of those incidents make their way to a FARS report.[17]

It is easy to become distracted while driving, and the use of cellphones while driving is not the only concern. There is evidence that the classic Borkenstein curve such as Figure 1, which shows the correlation between blood alcohol content and the risk of being in a crash, has moved to the left over the last several decades, due to increased traffic, more complex road systems and more distracting technology built into modern cars.[18] See also Figure 15 on page 33.

It is well-known[19] that marijuana affects an individual's performance in divided attention laboratory assays, and that it affects both occasional and chronic users. This is one reason why some assessments in the Standardized Field Sobriety Tests (SFSTs) that detect divided attention impairment are able to confirm impairment of marijuana-impaired drivers.[20] The practical effect of this is that it is easier for a drug-impaired driver to become distracted from the task at hand – driving safely. Was a crash caused by use of drugs, distraction or both? Would the driver have been distracted absent the use of drugs?

The bottom line: some drivers reported to be drunk were actually impaired by both alcohol and drugs, and are underreported in state statistics. Drug and alcohol use can exacerbate the effects of distracted driving. A drug-impaired driver can be more easily distracted than a non-impaired driver. Impairment is impairment, regardless of the cause. There is more merit to addressing all causes of unsafe driving than there is in trying to parse the exact contribution of each cause of unsafe driving.

Polydrug use impairs more than any single substance

Colorado's marijuana legalization has shone a spotlight on THC-impaired drivers, sometimes overlooking the fact that the driver was impaired by multiple drugs, including alcohol combined with marijuana. Our term polydrug includes use of any combination of two or more drugs and may include alcohol.

DUID Victim Voices studied crashes where Colorado drivers were cited for either vehicular homicide due to DUI or vehicular assault due to DUI in 2013.[21] Court records were studied for evidence of the cause of the DUI citation. Not surprisingly, alcohol was the principal cause of DUI, but marijuana *alone* tied for the fifth most common cause of DUI. See Table 2:

Table 2 Causes of DUI charges in Colorado's vehicular homicide and assault cases, 2013

Causes of DUI

Cause	Number	%
Alcohol	119	70.0%
Alcohol + marijuana	14	8.2%
Multiple drugs	8	4.7%
Alcohol + methamphetamine	5	2.9%
Alcohol + multiple drugs	3	1.8%
Marijuana	3	1.8%
Other drugs (meth, opiates, benzo or other)	6	3.5%
Alcohol + other drugs (opiates, cocaine, benzo or other)	6	3.5%
Drugs not identified	6	3.5%

Wood. J Safety Research. 2016

The weakness of the DUID Victim Voices study was the low numbers, the lack of access to forensic toxicology data, and incomplete court records. Nevertheless, it pointed out that polydrug impaired drivers may be more of a problem than drivers impaired by marijuana alone.

Washington State published its analysis of drivers involved in fatal crashes from 2008-2016.[22] Table 3 is constructed from data in that report. Washington reports carboxy-THC separately from THC. In the following table, carboxy-THC is considered to be benign.

Table 3 Drugs involved in fatal crashes – Washington

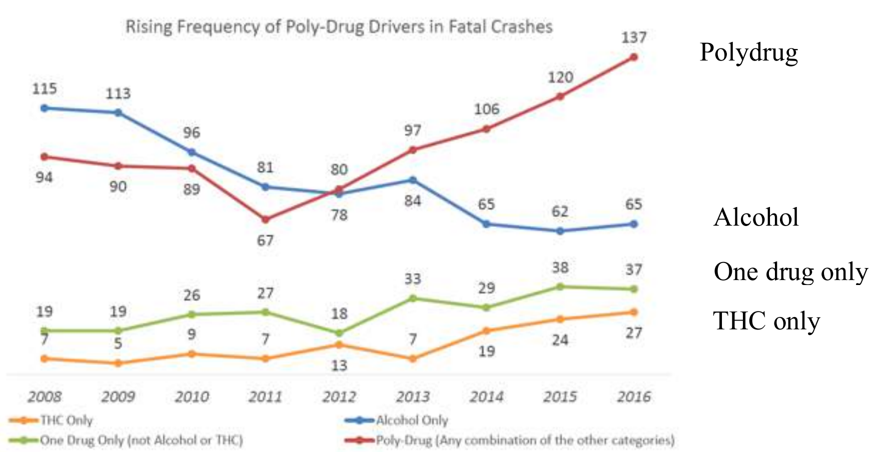
Substance	Number of drivers			Comments
Not tested			2,360	
No drugs, no alcohol			1,358	Includes 70 cases of carboxy-THC only
One or more intoxicant			2,003	60% of tested cases were positive, 35% of the total cases were positive. Only the former number is meaningful.
Single intoxicant		1,123		
Alcohol only	759			Includes 88 cases of alcohol + carboxy-THC only. 86% of alcohol only were ≧ 0.08 BAC
THC only	118			
Other drugs	246			Includes narcotics, depressants and stimulants
Polydrug		880		
Includes alcohol	492			39.3% were polydrug cases
Includes THC	329			73.6% were polydrug cases
Includes other drugs	637			71.8% were polydrug cases

Grondel. Washington Traffic Safety Commission. 2018

Clearly DUI is not just about alcohol and DUID is not just about marijuana. It's also clear that drug users (including marijuana users) are more inclined than drinkers to be polydrug users.

Furthermore, Washington reported that fatalities involving marijuana and other drugs are gradually rising, but polydrug fatalities are rising very rapidly (an average of 15% per year since 2012) and drunk driving (only) fatalities have dropped:

Figure 4



Grondel. Washington Traffic Safety Commission. 2018

The prevalence of polydrug use can pose a problem for law enforcement officers investigating a potential DUID case. Note the following to understand this.

Different drugs impact drivers differently, and present very different profiles to an officer investigating impaired driving. Table 4 shows this effect simply, if imprecisely.[23]

Table 4

Ways in which different drugs affect brain functioning

Drug class	Drug	Impairment						
		Drowsiness	Cognitive functions	Motor functions	Mood	Lateral vehicle control	Time estimation	Balance
Illicit drugs	Cannabis	●	●	●	●	●	●	●
	Cocaine	–	●	●	●	–	–	–
	Amphetamines	–	●	●	●	–	●	●
	MDMA[a]	–	●	–	●	–	–	●
	Hallucinogens	–	●	●	●	–	●	●
Prescription drugs	Benzodiazepines	●	●	●	–	●	–	●
	Opioids	●	●	●	●	●	–	●
	Other depressants	●	●	●	●	●	–	●
New psychoactive substances	Synthetic cannabinoids	●	●	●	●	●	●	●
	Synthetic cathinones	–	●	●	●	–	–	–

Source: Based upon reference *(9)*.
●: the drug has an impairment effect.
–: the drug has no impairment effect.
[a] Methylenedioxymethamphetamine.

A Policy Brief: Drug use and road safety. WHO. 2016

For example, amphetamines, far from causing drowsiness, make someone more alert during the "up" phase of the drug's metabolism. A person on both methamphetamine and heroin may show no signs of either drowsiness or hyperactivity.

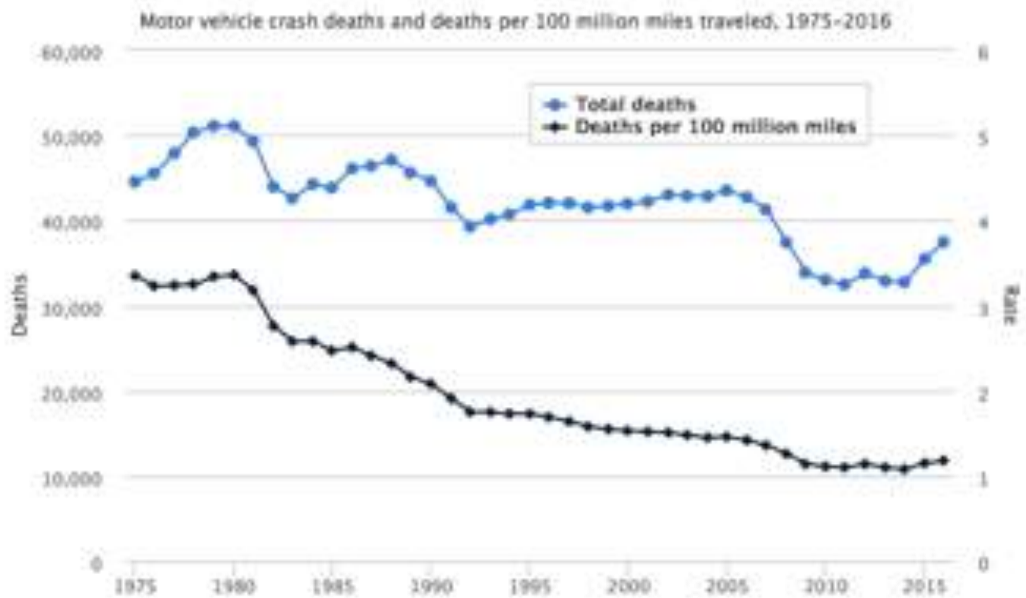
Amphetamines cause pupils to dilate, whereas opioids cause pupils to constrict. An officer investigating a driver impaired by both cannot use pupil size to determine the cause of the impairment.

In practice, usually one drug is more dominant in its effects than another, and the differences can be sorted out with a good interview.

Highway safety

Fortunately, highways are generally very safe and have been getting safer, at least until the last couple of years. See Figure 5[24].

Figure 5



Insurance Institute for Highway Safety. Highway Loss Data Institute, FARS analysis. 2018

In 2016, the number of deaths per 100 million vehicle miles traveled ticked up to 1.18. So a person driving 20,000 miles per year from the time of receiving a license until retirement will drive about 1 million miles, and therefore might expect to be in a fatal crash once every 85 *lifetimes*.

An adult driver with a blood alcohol content of .08 gm/dl will have a 10-fold increased risk of a fatal crash[25], but even that would forecast an average of 8.5 lifetimes before a fatality for an individual. This is one reason we have so many drunk drivers on the road, even though the risks are well-known. We simply have too many people playing the odds and most of them fortunately get away with it.

This poses a problem in conveying to the public the risk of both drunk and drugged driving. As we will see in the next chapter, driving stoned is statistically safer than driving drunk, which is of no consolation to victims of stoned driving. If it's been difficult to convince people to avoid driving drunk, it's that much more difficult to convince people to avoid driving while under the influence of drugs. Especially in a society that craves and believes in the legitimacy of self-"medication" and the recreational use of drugs.

Legalization of marijuana has certainly increased the number of traffic deaths, as should be expected, but because highway traffic deaths are statistically so low, legalization will not dramatically increase any single individual's chance of being killed, thereby causing a general alarm that would otherwise rally efforts to clamp down on driving under the influence of drugs.

Chapter 3
Marijuana-impaired driving facts and myths

Types of evidence

Scientists rely upon two types of evidence to understand the impact of marijuana use on safe driving:[26]

- Experimental evidence – laboratory tests, simulator tests, on-road driving
- Epidemiological evidence – culpability studies, case-control studies

Laboratories use tests such as Tower of London, Stop Signal Task, Critical Tracking Task, Time-Distance Perception, Divided Attention Task, Virtual Maze and Wisconsin Card Sorting Task. Laboratory studies have been conducted for decades all over the world with similar results. There is no scientific disagreement that marijuana causes measurable impairment.[27] But there is disagreement on how much that impairment increases risks to motorists.

Simulator studies are not only more difficult and expensive to conduct than laboratory studies, but they have been criticized as not replicating real-world conditions. Nevertheless, the best recent studies have confirmed marijuana's impairing effects on drivers.[28]

On-road driving tests are not only more difficult to perform than either laboratory tests or simulator studies, but they can be more dangerous, so they have rarely been used. Nevertheless, they also confirm marijuana's impairing effects on drivers.[29,30]

Experimental evidence proves that marijuana impairment is real. Epidemiological evidence shows the practical effects of that impairment on highway safety, answering the question of how much marijuana's impairment increases risks to motorists.

Whereas experimental studies logistically can only be performed on a limited number of subjects, epidemiological studies encompass thousands of real-world observations. Because they encompass thousands of observations, epidemiological studies are much more difficult to control than laboratory studies.

Scientists rely upon experimental evidence and epidemiological evidence. They place little value in single observations, opinions, and most "studies" done by TV reporters.

The following March 2018 JAMA editorial by Dr. Jan Ramaekers nicely summarizes the current scientific understanding of marijuana-impaired driving based on both experimental and epidemiological evidence. It also highlights the disconnect between public perception and reality. Ramaekers is one of the top impaired-driving experts in the world.

VIEWPOINT

Driving Under the Influence of Cannabis
An Increasing Public Health Concern

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Viewpoint

Driving is a complex task that requires integrity of sensory, motor, and cognitive function. The driving task may be compromised by factors related to the vehicle, the driving environment, and the driver. Driver impairment is a major cause of motor vehicle crashes and commonly results from alcohol intoxication.[1] Cannabis is the most frequently detected illicit drug among drivers involved in motor vehicle crashes, often in combination with alcohol.[1] Evidence from experimental and epidemiological studies indicates that cannabis also impairs driving performance and increases crash risk.[1,2] The prevalence of cannabis use is expected to increase following recent legalization of medical and recreational use in several countries worldwide and the introduction of a legal cannabis industry.[3] As a result, driving under the influence of cannabis has become an increasing public health concern.

Experimental laboratory studies have repeatedly demonstrated that the primary component of cannabis (ie, of Δ^9-tetrahydrocannabinol [THC]) impairs the motor performance (eg, reaction time, tracking) and cognitive function (eg, attention, decision making, impulse control, memory) needed for safe driving in a dose-related manner.[1,2] Performance impairments are maximal during the first hour after smoking and decline over 2 to 4 hours after cannabis use.[2]

Various studies have shown that the combined use of cannabis and alcohol is associated with greater crash risk than the use of either alone.

Standard deviation of lateral position (SDLP), a measure of "weaving" or road tracking control as measured in on-road driving tests in actual traffic, appeared to be one of the most sensitive measures to detect THC-induced driving impairment. A study in 18 participants showed that smoking low (100 μg/kg of THC) and medium (200 μg/kg of THC) doses of cannabis significantly increased SDLP in a dose-related manner. The SDLP further increased when cannabis was combined with a low alcohol dose that produced a blood alcohol concentration (BAC) of 0.04 g/dL.[4]

In addition, the time spent driving outside of the traffic lane increased exponentially with increasing SDLP (r = 0.94) and was maximal (1.1%, about 40 seconds during the 1-hour driving test) following combined use of cannabis and alcohol. Mean increments in SDLP associated with cannabis use were equivalent to changes in SDLP previously observed in drivers performing the on-road test with a BAC of 0.05 g/dL, the level of legal impairment in many European countries. Blood alcohol concentrations at or above this level have been associated with a substantial increase in crash risk.[1] Cannabis in combination with alcohol produced a mean increase in SDLP that was equivalent to that associated with a BAC greater than 0.10 g/dL, which is greater than the level of legal impairment in the United States.

Findings from on-road studies indicating that cannabis alone and combined with alcohol impairs road tracking have been replicated in driving simulator studies,[1,2] supporting their validity and reliability. On-road and driving simulator studies also have shown that cannabis produces dose-related impairments of distance keeping and reaction time that added to those of alcohol when given in combination.[1,2] In these studies, drivers were aware of their driving impairment. Consequently, they invested more effort, drove at a greater distance from other vehicles, and slightly adjusted their speed.[1] Yet, drivers were unable to compensate for the adverse effects of cannabis on lateral position because road tracking performance is a highly overlearned, habitual, and automated process that operates outside of conscious control.

Other laboratory studies have explored the possibility that the impairing effects of THC might be substantially reduced after repeated use owing to tolerance but provided little empirical evidence for this assumption. Cognitive and psychomotor impairments were blunted in (some) regular cannabis users but were nevertheless evident across multiple performance domains.[5] An on-road driving study involving 24 participants[6] demonstrated that acute administrations of dronabinol (10 mg and 20 mg), a synthetic THC prescribed to treat anorexia in wasting diseases and emesis in patients with cancer and chronic pain, increased SDLP and reaction time in occasional as well as heavy (daily and near daily) cannabis users. Increments in SDLP were comparable with impairments associated with BACs of 0.08 to 0.10 g/dL in occasional users. The magnitude of driving impairment was generally less among heavy users but still comparable with a BAC of 0.05 g/dL, particularly after the higher dose of THC.

Epidemiological findings on the role of THC in vehicle crashes show that cannabis use among drivers is associated with a moderate (about 1.2- to 2.0-fold) increase in crash risk,[7] less of an effect than might have been predicted from experimental research. Various studies have shown that the combined use of cannabis and alcohol is associated with greater crash risk than the use of either alone.[1] A significant problem with epide-

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miological studies is that (blood) samples for drug screening are often taken 3 to 4 hours after a crash. Concentrations of THC in these samples are usually very low (around 1 ng/mL) and not representative of the event because THC concentrations decline very rapidly after smoking. Moreover, low THC blood concentrations are not necessarily an indication of recent use but may also reflect past use in nonimpaired drivers. Most epidemiological studies therefore have been unable to estimate crash risk of drivers during the acute intoxication phase of cannabis use. Those that did collect blood samples closer to the crash event typically reported higher associations (odds ratios of 2-14) between cannabis use and crash risk at THC concentrations above 5 ng/mL.[7]

Scientific evidence on the association between cannabis use and driving impairment contrasts with public attitudes toward driving under the influence of cannabis. Regular cannabis users often admit to driving under the influence of cannabis and wrongfully believe that cannabis does not affect their driving performance or that they can compensate for cannabis-associated impairment.[2] Consuming cannabis with or without alcohol is a common occurrence that causes substantial risk to intoxicated drivers and road users in general. In a policy brief by the World Health Organization, driving under the influence of cannabis was estimated to be responsible for slightly more than 8700 road traffic deaths worldwide in 2013.[8] This is still far less than the number of deaths due to alcohol-impaired driving in the same year (slightly more than 188 000) but does underscore the importance of developing evidence-based policy and legislation to counteract the safety risks posed by driving under the influence of cannabis.

ARTICLE INFORMATION

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CDPHE Report

The Colorado Department of Public Health and Environment has published two "Monitoring Health Concerns Related to Marijuana" reports, the latest in 2016.[31] Following are the summary statements from their most recent report:

Evidence statements

Evidence statements are based on systematic scientific literature reviews performed by Colorado Department of Public Health and Environment staff with oversight and approval by the Retail Marijuana Public Health Advisory Committee. For an explanation of the classifications "Substantial," "Moderate," etc., see Chapter 7. Systematic literature review process. For details about the studies reviewed, see Appendix K.

Impairment and crash risk

1. We found SUBSTANTIAL evidence that recent marijuana use by a driver increases their risk of motor vehicle crash.[7-11](Revised*)
2. We found MODERATE evidence for a positive relationship between THC blood level and motor vehicle crash risk.[12-15] (Revised*)
3. We found SUBSTANTIAL evidence that for marijuana users who use less-than-weekly, there is meaningful driving impairment with a whole blood THC of 2-5 ng/mL.[8,16-18]
4. We found SUBSTANTIAL evidence that for marijuana users who use less-than-weekly, smoking more than about 10 mg THC (or part of a currently available marijuana cigarette) is likely to meaningfully impair driving ability.[16,17,19-30]
5. We found SUBSTANTIAL evidence that for marijuana users who use less-than-weekly, orally ingesting 10 mg or more of THC is likely to meaningfully impair driving ability.[17,20,31,32]
6. We found MODERATE evidence that blood THC levels of marijuana-impaired drivers are higher now than in the past.[33]
7. We found INSUFFICIENT evidence to determine whether or not motor vehicle crash risk differs for users who use less-than-weekly compared to daily or near-daily users.[34-37]

Combined marijuana and alcohol use

8. We found SUBSTANTIAL evidence that the combined use of marijuana and alcohol increases impairment and motor vehicle crash risk more than use of either substance alone.[12,14,15,38-42]

Time to wait before driving

9. We found SUBSTANTIAL evidence that delaying driving for at least 6 hours after smoking less than 18 mg THC allows THC-induced impairment to resolve or nearly resolve for users who use less-than-weekly.[8,16,17,19,26,43]
10. We found MODERATE evidence that delaying driving at least 6 hours after smoking about 35 mg THC allows THC-induced impairment to resolve or nearly resolve for users who use less-than-weekly.[22,25,26]
11. We found SUBSTANTIAL evidence that delaying driving at least 8 hours after oral ingestion of less than 18 mg THC allows THC-induced impairment to resolve or nearly resolve for users who use less-than-weekly.[17,20,32,44]
12. We found INSUFFICIENT evidence to determine the amount of time necessary to wait after smoking more than 35 mg THC to allow THC-induced impairment to resolve for users who use less-than-weekly.[17,22,45]
13. We found INSUFFICIENT evidence to determine the amount of time necessary to delay driving to allow THC-induced impairment to resolve or nearly resolve for daily or near-daily users after using marijuana.[8,21,25,29,46,47]
14. We found INSUFFICIENT evidence to determine the amount of time to delay driving after other methods of marijuana use (such as vaporizing or application of dermal or mucosal preparations).

No correlation between THC levels and impairment levels

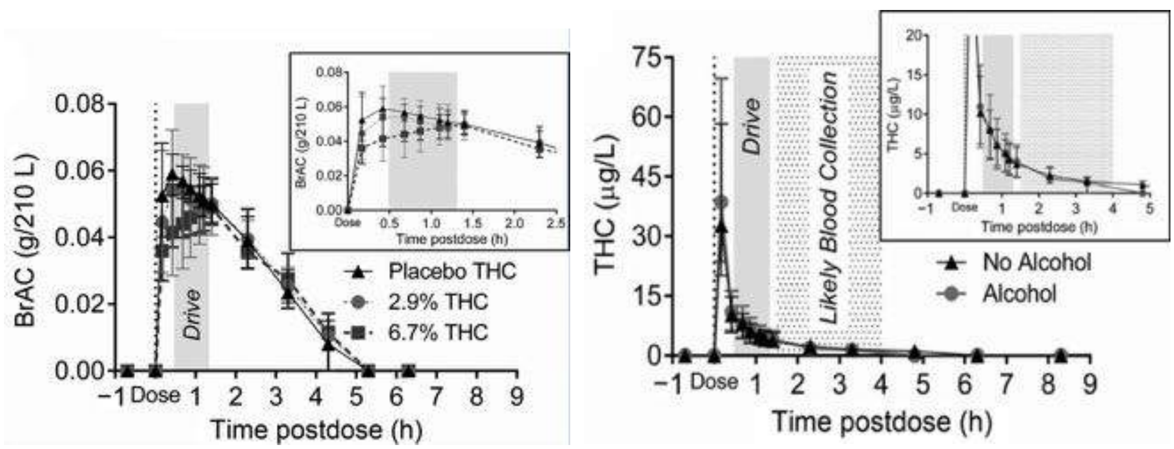
Chapter 1's section on Legal Limits described why there is no correlation between THC levels and impairment. Following is a discussion of the published research on this topic, followed by an analysis of what this means for THC *per se* or permissible inference levels.

The level of impairment caused by marijuana is dose-dependent[32] somewhat like alcohol, meaning that a large dose of marijuana is more impairing than a small dose. But that cannot be demonstrated forensically because blood levels of THC tested by toxicology labs do not represent the blood levels of THC at the time of the crash. Forensic lab results cannot discern the difference between a small dose and a large dose because of the high variation in delay times between marijuana consumption and blood sampling.

Compare the two distribution/metabolism curves for alcohol and THC in Figure 6[33]:

Figure 6 – Alcohol and THC blood clearance mechanisms

Alcohol THC



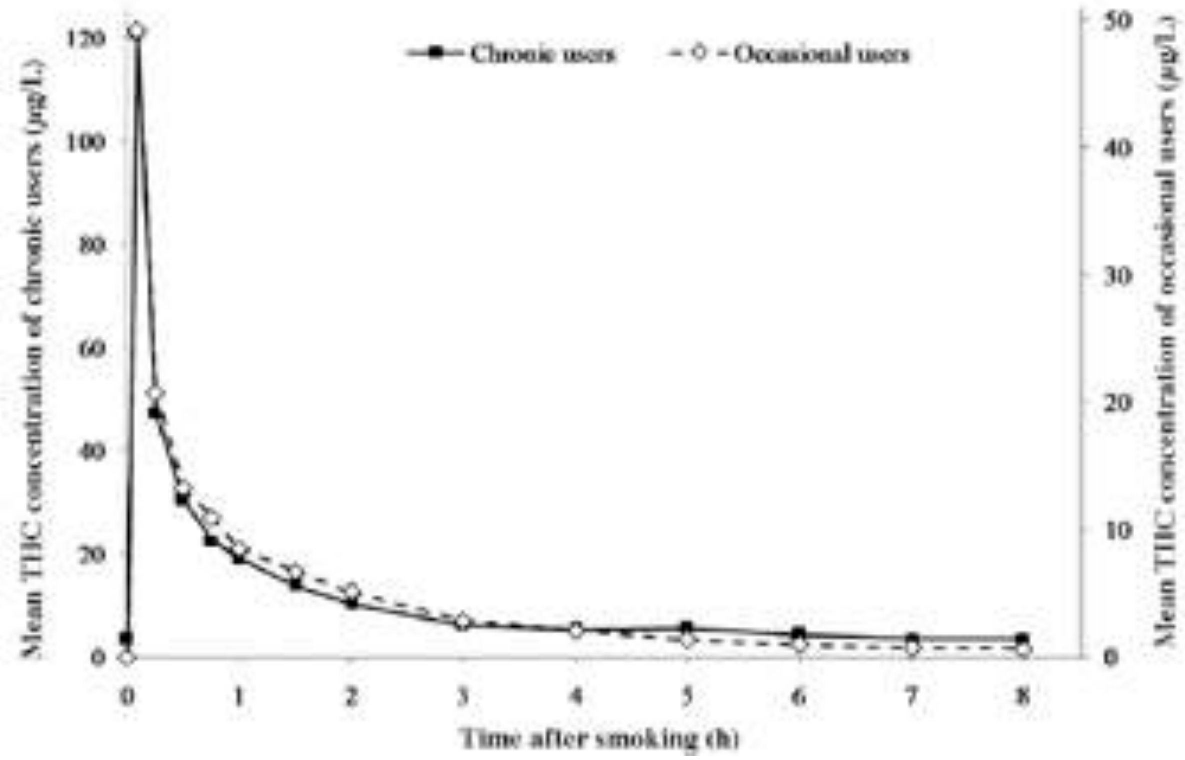
For alcohol	For THC
Removed by metabolism	Removed primarily from blood by redistribution
Metabolism is linear	Metabolism is first order kinetic
Metabolism .015-.020 gm/dl-hr	Metabolic half-life is ~4.1 days
Can use retrograde extrapolation	Retrograde extrapolation is impossible
Measurement within 2 hr is OK	Average 73% reduction within 25 minutes (Range of 6.6% to 89.5%)

Hartman. Clinical Chemistry. 2015

This rapid redistribution of THC from the blood to the brain occurs regardless of whether or not the user is an occasional user or a chronic user. The difference between the two is that a chronic user starts at a much higher level of THC after acute exposure, and the asymptotic lower limit is higher; but the redistribution curve is identical.[34] See Figure 7.

Figure 7

Overlay of mean THC concentrations of occasional and heavy users, normalized



Toennes. J Anal Tox. 2008

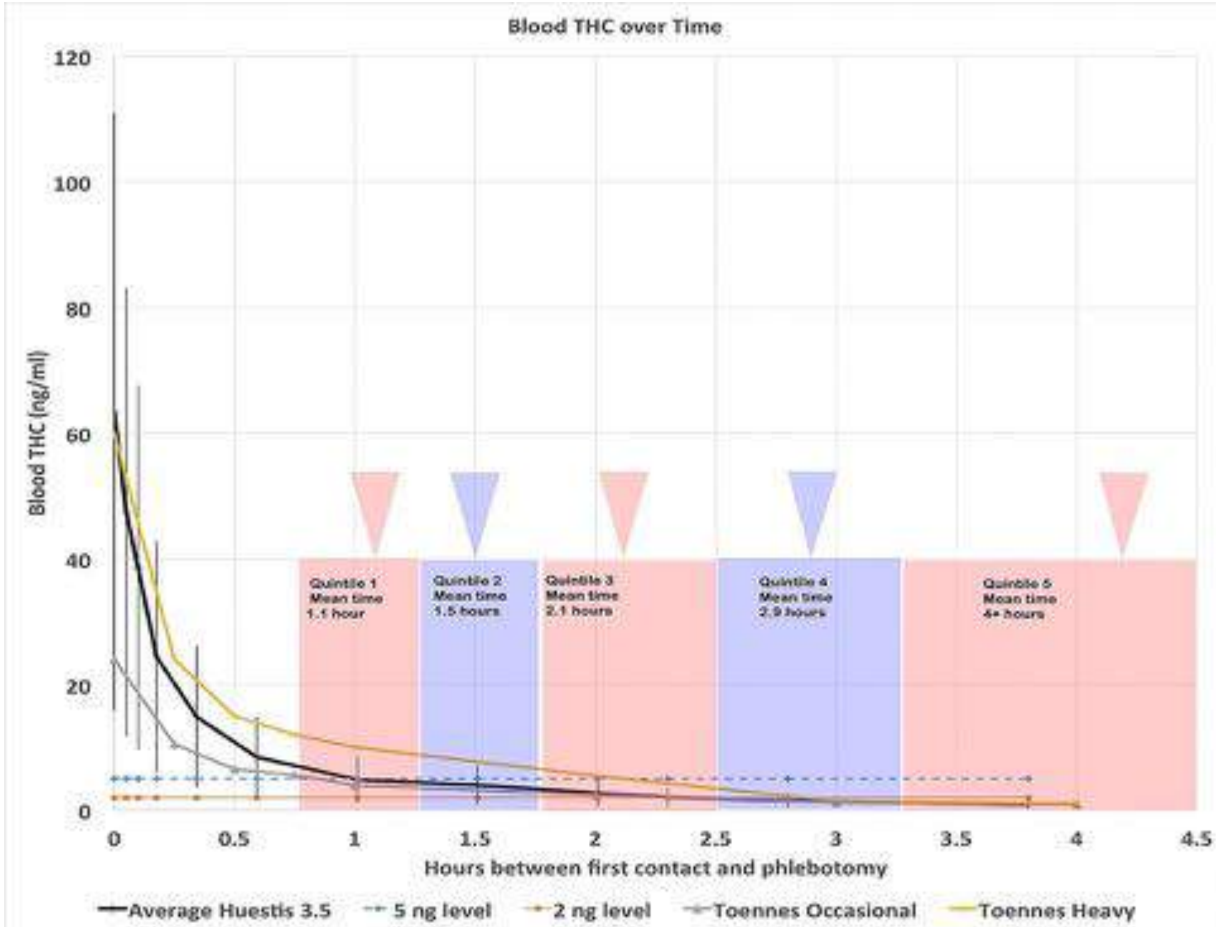
Blood cannot be collected for a drug test at the instant of a crash or DUI arrest. During the blood sample delay there can be a very rapid redistribution of THC from the blood to the brain and other fatty tissues. So unlike alcohol, the level of THC in forensic tests cannot represent the level of THC at the time of the event leading to the arrest.

Even if it were possible to instantaneously collect blood from a driver at the time of an event leading to a DUI arrest, that wouldn't tell us how much THC is in the brain – the only place that matters.

Hartman reported that the typical delay between an arrest event and collecting a blood sample was 1.5 to 4 hours, depending on the type of case.[35] Urfer reported a typical delay time of 1.05 hour in 1,288 Colorado cases, mostly proactive stops (stop for cause, not due to crashes).[36] Wood reported a median delay of 2 hours in Colorado for crashes resulting in death or serious bodily injury, and 3½ hours if a warrant was required to draw blood.[37]

The effect of delay on the meaningfulness of forensically-determined blood levels of THC can be seen in a hypothetical case of a driver smoking marijuana at the time of a crash or arrest. Figure 8 overlays the THC elimination curves of Figure 6 and Figure 7 with the histogram of delay times reported in the Wood study of Colorado fatal/injury crashes[38].

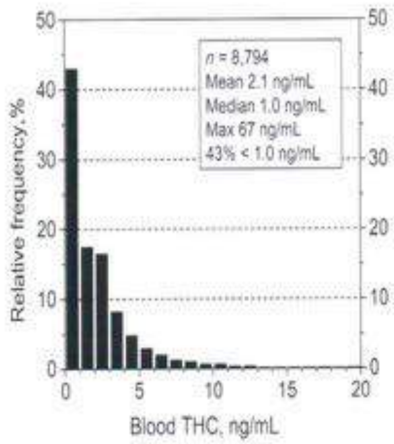
Figure 8   Impact of sample delay on THC blood level validity



The median whole blood THC level would be just over 2 ng/ml for the occasional user and slightly above 5 ng/ml for the heavy chronic user. And that's for someone smoking marijuana at the time of a crash!

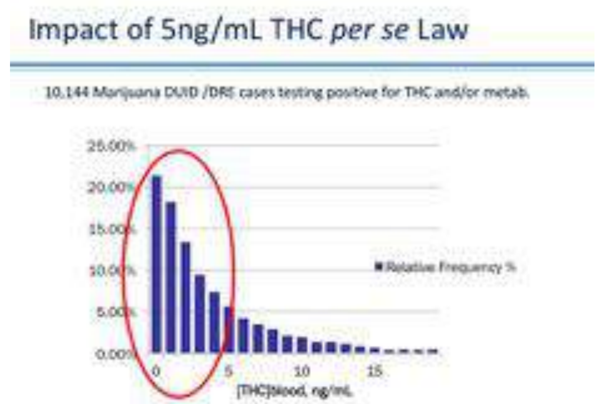
This explains in part why the vast majority of blood tests of drivers arrested on suspicion of driving under the influence of marijuana test *below* Colorado's 5 ng/ml permissible inference level. See Figure 9, showing a histogram of blood THC levels taken over a 10 year period in Sweden[39] (90% below 5 ng/ml), Figure 10 showing a histogram of blood THC levels of 10,144 samples tested by NMS Labs in Pennsylvania (72% below 5 ng/ml)[40] and Figure 11 showing a histogram of blood THC levels tested by CDPHE in 2011 (70% below 5 ng/ml)[41]. Smaller recent studies have shown similar results ranging from 45% to 70% below 5 ng/ml.

Figure 9



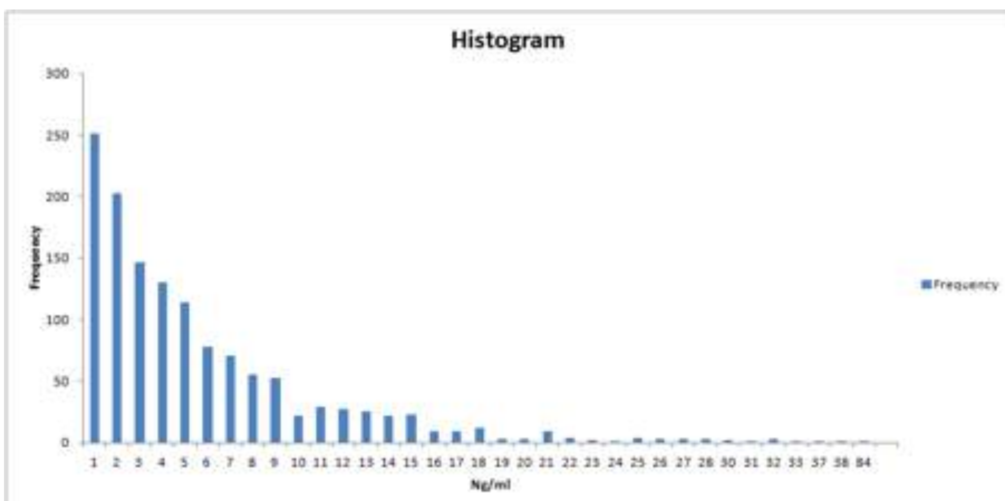
Jones. Addiction. 2008

Figure 10



Logan. NMS. 2015

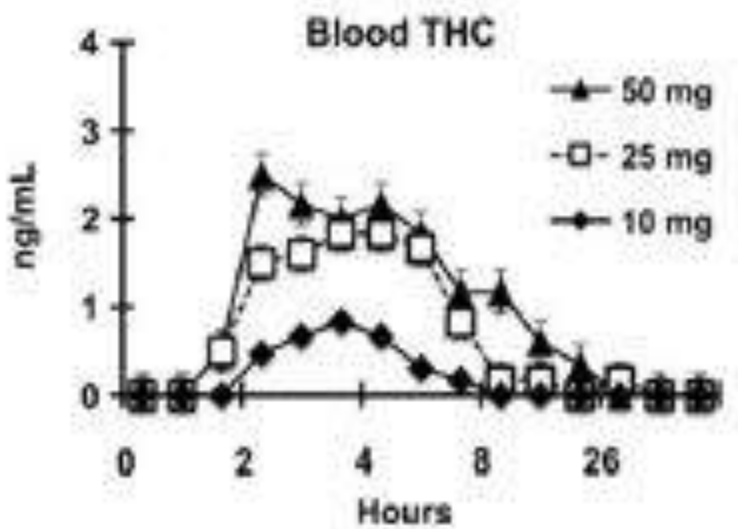
Figure 11



Burbach. CDPHE

The huge number of test results below 5 ng/ml is not just because of redistribution of THC between the time of arrest and blood draw. The use of edible marijuana products the other major reason. THC from marijuana edibles enters the bloodstream very slowly compared with THC from inhaled marijuana, either smoked or vaped. Therefore, THC from edibles is absorbed by the brain and other fatty tissues before a high level builds up in the bloodstream. Since THC is slowly released from the digestive system, the edibles' impairment period lasts longer than impairment from inhaled marijuana and it subsides more slowly. Vandry[42] published his detailed studies of this in 2017, shown in Figure 12. Blood THC levels never rise above 3 ng/ml in whole blood, and that's for someone consuming five times the standard 10 mg dose.

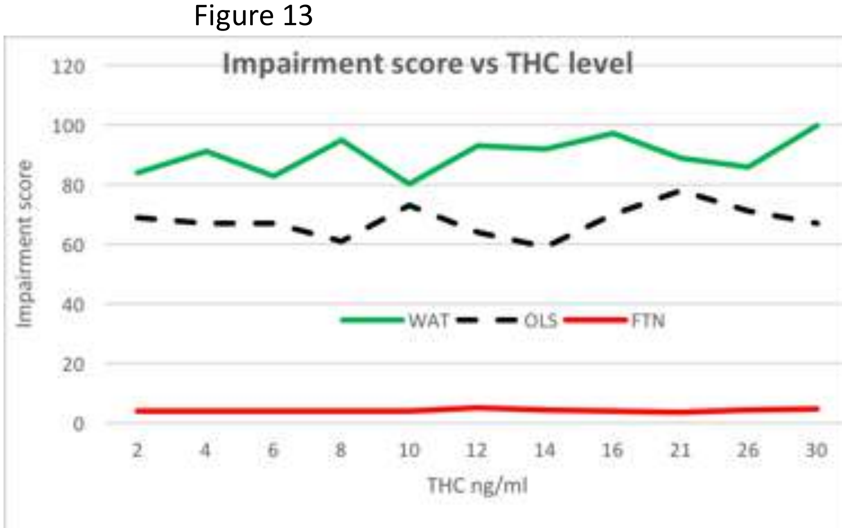
Figure 12 Blood THC levels over time at three edible doses



Vandry. J Anal Tox. 2017

Let's now move from biology to experimental evidence that demonstrates the lack of correlation between blood THC level and impairment. California's Orange County Crime Lab published a two-year study of nearly 5,000 drivers arrested for suspicion of driving under the influence of drugs.[43] The study consisted of only drivers arrested for DUI and no controls were used. Therefore, the study cannot be used to infer the success of Standardized Field Sobriety Tests to detect drug impairment. The study found no relationship between three field sobriety tests (Walk And Turn, One Leg Stand, and Finger To Nose) and the blood level of THC. Refer to Figure 13. A driver could be just as impaired at 2 ng/ml THC as at 30 ng/ml THC.

Figure 13

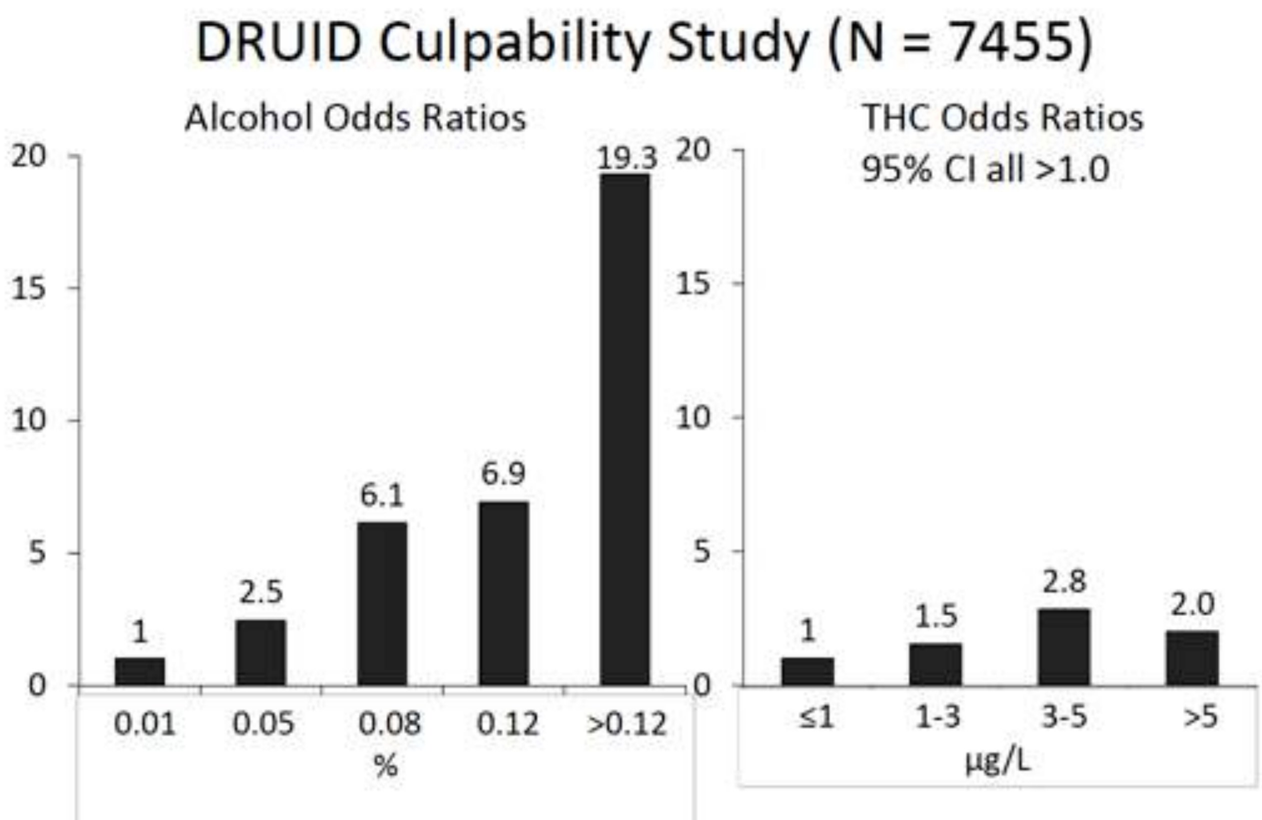


Declues. J Forensic Sci. 2016

The AAA Research Foundation published a monograph in 2016 studying the issue further, comparing 602 drivers arrested for impaired driving in which only THC was present, along with a sample of 349 drug-free controls. The roadside assessment tests were able to readily differentiate impaired drivers from drug-free controls but confirmed the Orange County results that impairment assessments did not correlate with blood THC levels. The AAA research used a battery of 16 different roadside assessments. The report concluded, **"Based on this analysis, a quantitative threshold for *per se* laws for THC following cannabis use cannot be scientifically supported."**[44]

Epidemiological evidence also cannot support a correlation between blood THC levels and risk of either fatal crashes or serious bodily injury crashes, according to the DRUID analysis performed in Germany, Belgium, Netherlands, Portugal, Italy, Denmark, Latvia, Sweden, Norway and Finland.[45] See Figure 14, showing that the typical Borkenstein-type relationship was duplicated for alcohol, but no relationship existed for THC. Someone was as likely to be killed by a driver with a 1 ng/ml THC blood level as by a driver with a THC blood level above 5 ng/ml. The study was a case-control experiment with 2,490 subjects and 15,832 controls.

Figure 14



Hels. DRUID Final Conference. 2011

Odds ratio studies

The odds ratio is the primary outcome of most case-controlled epidemiological studies. The odds ratio, or OR is the odds that an outcome (e.g. crash, fatality, serious injury) will occur given a particular drug exposure, compared to the odds of the outcome occurring in the absence of that exposure. An OR of 15 for fatal crashes for a driver with a BAC of 0.10, for example, means that a driver with a BAC of 0.10 has 15 times the likelihood of being involved in a fatal crash than an identical sober driver at the same time, place and under the same conditions. An OR of 1.5 would mean a 50% greater chance of being involved in a fatal crash.

Published OR and Relative Risk (RR) studies of marijuana impairment are fraught with inconsistencies made necessary by the impossibility of getting perfect data. That is why studies refer to their results as OR estimates, rather than final determinations.

Conceptually, Odds Ratio (OR) and Relative Risk (RR) studies should be easy to perform by obtaining only four pieces of information:

a	=	Number of crashes by impaired drivers
b	=	Number of non-crashes by impaired drivers
c	=	Number of crashes by non-impaired drivers
d	=	Number of non-crashes by non-impaired drivers

	Drivers in crashes	Drivers not in crashes
Drug-positive (impaired) drivers	a	b
Drug-negative (sober) drivers	c	d

$$OR = \frac{a/b}{c/d} \qquad RR = \frac{a/(a+b)}{c/(c+d)}$$

Since traffic crashes are very rare, the difference between OR and RR is inconsequential so many papers refer to the two terms interchangeably, although strictly speaking, they are not.

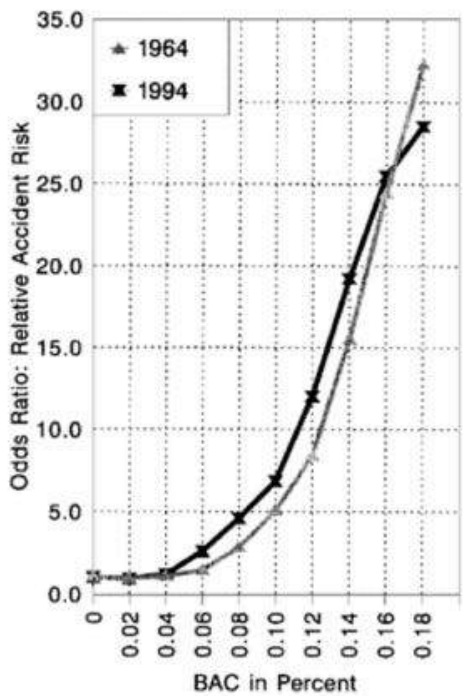
It is relatively easy to obtain “a” and “c” from traffic incident reports and/or laboratory assays of drivers involved in crashes. Obtaining “b” & “d” is more problematic. Most authors rely upon surveys and prevalence reports that must then be adjusted to ensure the data pools have similar ages, genders, and many other confounding co-variates. Authors disclose their adjustment factors to ensure adjustments are legitimate and that any potential for data bias can be identified.

Because of the difficulty in obtaining unbiased data, published ORs have varied widely for marijuana impairment. Recent OR crash risk estimates for marijuana impairment have varied from Romano’s 0.86[46] to Kuypers’ 13.4[47].

Odds Ratio studies for alcohol differ from those for marijuana in that alcohol studies report OR as a function of the blood alcohol level. That has rarely been done for marijuana since there is a poor correlation between demonstrated impairment and forensically-determined THC blood levels for the reasons described above. This is in spite of the fact that Robbe[48] and others have shown that the degree of impairment caused by THC is a function of the amount of THC consumed.

Figure 15[49] and Figure 1 show examples of alcohol OR studies.

Figure 15 Odds ratio as a function of BAC



Krüger, Int'l Conf on Alcohol, Drugs & Traffic Safety

All but a mere handful of OR studies for marijuana have simply measured the odds ratio of drivers with <u>any</u> THC blood level, compared with drivers where no THC was found. The few exceptions include the Hels report shown in Fig. 14 and those shown in Table 6.

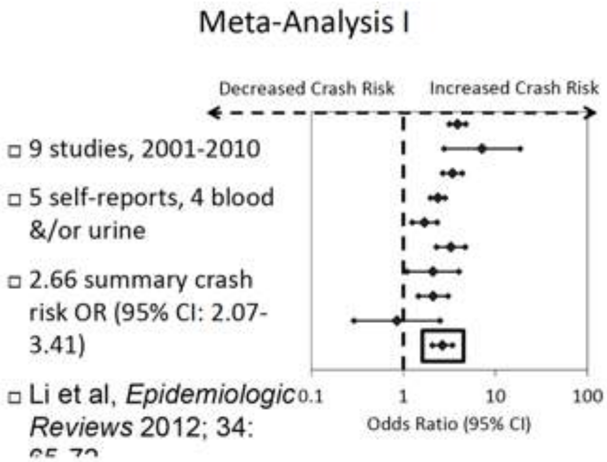
Table 6

Author	**Ref.**	**OR 1-2 ng/ml**	**OR 3-4 ng/ml**	**OR 5+ ng/ml**
Kuypers, '12	50	7	25	14
Laumon, 05	51	2	3	3
Drummer, '04	52	3		7

There have been literally thousands of marijuana OR reports from around the world, with varying results. This has enabled researchers to perform meta-analyses, which is a way of blending the results of comparable research reports to arrive at an average result.

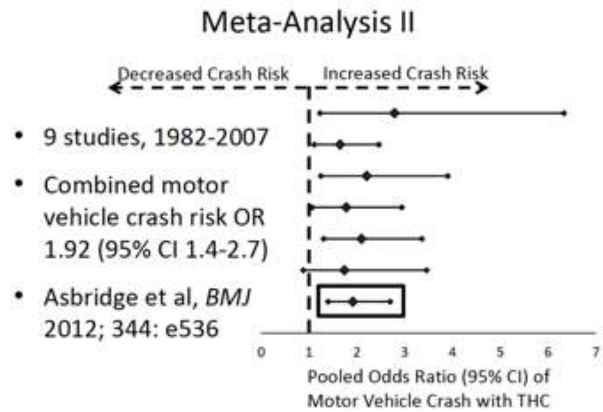
Mu-Chen Li published such a meta-analysis in 2011. He found 2,960 reports in the literature, some of higher quality than others. He and his team selected 9 comparable high quality studies, combined their results and arrived at an OR estimate of a 2.66 for marijuana-impaired drivers causing fatal crashes, with a 95% confidence interval between 2.07 and 3.41.[53] See the range of study results in Table 7.

Table 7



Li, M-C. Epidemiological Reviews. 2011

Table 8



Asbridge. Brit Med J. 2012

Mark Asbridge published a similar meta-analysis one year later.[54] Asbridge pared 2,975 studies down to 9 that were of high quality and contained data presented such that they could be properly pooled. The combined observations from the 9 studies was 49,411 subjects. His results were similar to Li's, as shown in Table 8, showing an OR of 1.92 with a 95% confidence interval between 1.4 and 2.7.

When discussing OR estimates, it is essential to understand the reasons for inconsistencies from one study to another, and the wide confidence intervals of the published studies. Doing so also helps understand why some estimates even fall below 1.0, indicating no impact of marijuana on driving safety.

Romano published an instructive analysis[55] of both his marijuana OR paper[56] and that of Guoha Li et al.[57] Both authors used FARS for study subjects and the National Roadside Survey for controls, yet arrived at very different OR results (0.86 vs 1.83). Romano found that study subject selection created a bias in both cases. By choosing different study subjects to eliminate biases and recalculating ORs using each author's disclosed methods, the two studies yielded results that were no longer statistically different (1.22 vs 1.27).

Rogeberg and Elvik reviewed 28 OR estimates from 21 epidemiological studies, recalculating their results to avoid biases and achieve standardized assumptions[58]. They arrived at an OR of 1.36 for crash risk due to marijuana intoxication and recent use. Prompted by commentary[59] from Gjerde et al., Rogeberg and Elvik recalculated[60] this to be 1.35 but added an additional important insight.

They noted that subjects in the epidemiological studies are of three categories:

- Non-users of marijuana
- Low THC drivers (neither intoxicated nor impaired)
- High THC drivers (intoxicated and impaired)

Laumon[61] and Kuypers[62] previously found that about one-third of subjects in their studies had high levels (≧ 5 ng/ml) of THC and were therefore presumably impaired and would fall into Rogeberg and Elvik's third category. Drummer, in contrast, found 84% of his subjects were ≧ 5 ng/ml . Assuming that one-third is representative of all 21 studies reviewed by Rogeberg and Elvik, and further assuming that the OR of non-users and low THC drivers is 1 (no increased crash risk) suggests that the high THC drivers had an OR of 2.1:

$$(0.67 \times 1) + (0.33 \times \mathbf{2.1}) = 1.36$$

Rogeberg pointed out that if the two-thirds of low THC drivers had an actual OR of 1.2, perhaps due to a low level of chronic, rather than acute impairment, then simple arithmetic dictates that the remaining high THC drivers had an actual OR of 1.7, rather than 2.1.

We clearly don't have precise determinations of ORs of marijuana involved or caused crashes. But there is emerging a consensus that the OR of marijuana-impairment causing a fatal crash is about 2, and perhaps less. There is agreement among all researchers that marijuana causes impairment and deaths due to traffic collisions, and that the level of impairment and danger is less than that of alcohol.

The OR estimates vary widely, which gives cover to those who wish to deny that marijuana causes traffic deaths. See, for example, information presented to Congress by the National Cannabis Industry Association[63]. But it's a false cover.

Developing ORs for other drugs has been even more problematic. The lower prevalence of other drugs requires a very large number of observations (several thousand at a minimum) for a confident analysis. Nevertheless, the European DRUID multi-country study[64] was able to compile the following data on Table 9.

Table 9

DRUID Fatal Crashes

Crude and adjusted odds ratios including confidence intervals of getting killed when driving substances, based on data from all countries (method 1). The reference group was negative for all substances

Substance	Crude OR	C.I.	Adjusted OR	C.I.
Negative (ref.)	1		1	
All alcohol concentrations	37.64	29.36-48.24	34.9	27.00-45.11
0.1 g/L ≤ alcohol < 0.5 g/L	9.23	6.07-14.05	8.01	5.22-12.29
0.5 g/L ≤ alcohol < 0.8 g/L	42.94	21.99-83.86	45.93	23.02-91.66
0.8 g/L ≤alcohol < 1.2 g/L	34.81	16.02-75.65	35.69	15.68-81.22
Alcohol ≥ 1.2 g/L	450.37	224.06-905.25	500.04	238.07-inf.
All illicit drugs	3.85	2.17-6.80	3.55	1.97-6.42
Amphetamine	25.44*	10.81-59.90	24.09	9.72-59.71
Benzoylecgonine	6.87*	1.49-31.76	n.a.	
Cocaine	22.34*	3.66-136.53	n.a.	
Cannabis	1.8*	0.73-4.44	1.33	0.48-3.67
Illicit opiates	10.04*	2.04-49.32	n.a.	
All medicines	5.05	3.80-6.72	5.29	3.95-7.08
Benzodiazepines and Z-drugs	5.11	3.72-7.02	5.40	3.90-7.46
Medicinal opioids	4.82	2.61-8.88	4.82	2.60-8.93
All alcohol-drug combinations	41.22	22.59-75.24	31.52	16.83-59.05
All multiple drug combinations	16.77	9.95-28.27	18.51	10.84-31.63

*: In the case of 0 counts in one of the categories a, b, c, d (cf. Table 12), 0.5 was added to all four cells to be able to calculate crude OR (Greenland et al., 2000). n.a.: no positive controls and/or no positive cases or (adjusted OR only) too few positive cases

Huestis. ACMT Seminars. 2015

Although some claim that marijuana-impaired driving is safer than alcohol-impaired driving, the same can be said for cocaine, amphetamines and opioids. All of these drugs, including marijuana, are more dangerous than sober driving. A person killed by a marijuana-impaired driver is just as dead as one killed by an alcohol-impaired driver. Moreover, the common combination of alcohol and marijuana is far more deadly than either drug separately.

Due to the wide confidence intervals found in the DRUID study, Europeans have found it more useful to categorize drugged driving danger as shown in Table 10.

Table 10 Drug danger levels

Overall conclusion

DRUID

Risk level	Risk	Substance group
Slightly increased risk	1-3	0.1 g/L ≤ alcohol in blood < 0.5 g/L Cannabis
Medium increased risk	2-10	0.5 g/L ≤ alcohol in blood < 0.8 g/L Benzoylecgonine Cocaine Illicit opiates Benzodiazepines and Z-drugs Medicinal opioids
Highly increased risk	5-30	0.8 g/L ≤ alcohol in blood < 1.2 g/L Amphetamines Multiple drugs
Extremely increased risk	20-200	Alcohol in blood ≥ 1.2 g/L Alcohol in combination with drugs

Cannabis and amphetamines: due to very different single country estimates, the risk estimate must be treated with caution (for amphetamines: see also next slide)
Benzoylecgonine, cocaine and illicit opiates: due to few positive cases and controls, the risk estimates must be treated with caution

Hels. DRUID Final Conference. 2011

Tolerance and addiction

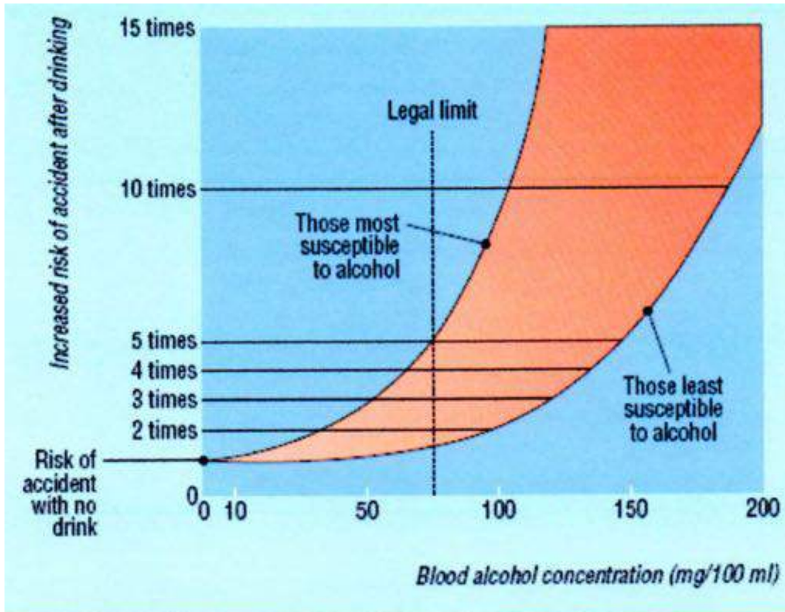
In most discussions of marijuana-impaired driving, the subject of tolerance arises. Some marijuana addicts and other heavy users claim they can drive safely after using marijuana because they have built up a tolerance to its effects. This is perplexing, because if it is true, then perhaps society would need one set of standards for a chronic user, and another for an occasional user.

Tolerance is very real, and is measured primarily by how high a dose of a drug is required to achieve a desired effect. To some extent, this is based on individual susceptibility, body size and body mass index. But even for a single individual, regular use of a drug creates a tolerance such that, with increasing use, a greater amount is needed to achieve a desired effect.

Opioids present an extreme example. A heroin addict on methadone maintenance treatment will usually require a dose of 20 - 100 mg daily to maintain performance without going into withdrawal. At that dose and in the absence of other drugs, the addict is usually not impaired, at least after an brief initial phase. But for a non-addict, a 25 mg dose can be lethal.[65]

Users can also become tolerant to alcohol, but to a far less extent. A heavy user may require twice the dose of alcohol to achieve the same level of impairment as a non-tolerant user as demonstrated by Paton[66] in Figure 16.

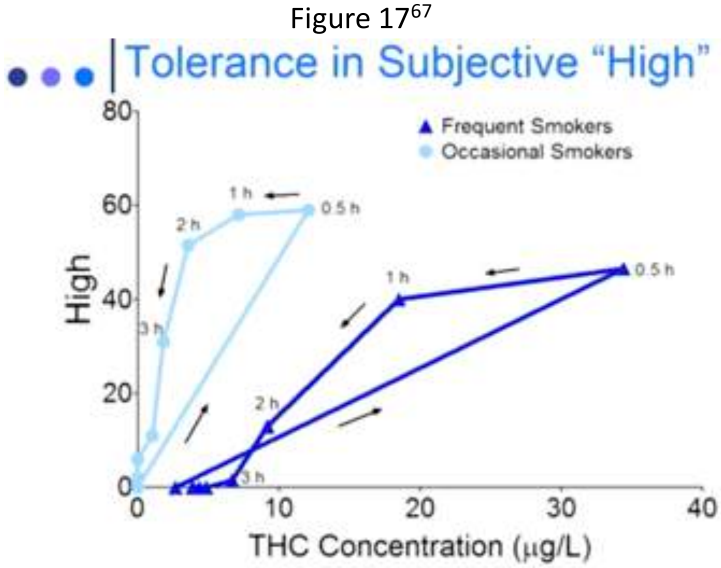
Figure 16 Alcohol tolerance



Paton. Brit Med J. 2005

Tolerance to marijuana is somewhere between the tolerance potential for alcohol and that for opioids as shown in Figure 17. Note that frequent users had a baseline THC blood level above zero, had a much higher THC blood level after dosing, but didn't feel as high as an occasional user. The maximum THC blood levels are consistent with what Toennes et al. showed in Figure 7 above.

Figure 17[67]



Huestis. DUID Heritage Summit. 2018

The American Psychiatric Association publishes a Diagnostic and Statistical Manual for use by its members. The DSM-V version describes Substance Use Disorder, popularly known as drug addiction. A substance use disorder is, "a cluster of symptoms indicating a person continues to use despite significant substance-related problems."[68] Diagnostic criteria for a substance use disorder are shown in Table 11.

Table 11 Substance Use Disorder Diagnostic Criteria

1	Substances taken in larger amounts or longer than intended
2	A persistent desire or unsuccessful effort to cut down or control use
3	A great deal of time is spent obtaining, using and recovering from effects
4	Cravings, strong desire or urge to use
5	Failure to fulfill major role obligations at work, school or home
6	Persistent or recurrent social/interpersonal problems caused or exacerbated by use
7	Social, occupational, or recreational activities are given up or reduced
8	Recurrent use in situations in which it is physically hazardous
9	Use is continued despite knowledge of physical or psychological problems
10	Tolerance – need for increased amounts or diminished effects
11	Withdrawal – symptoms or use to avoid symptoms

0-1: no diagnosis; 2-3: mild SUD; 4-5: moderate SUD; 6-11: severe SUD

Tolerance is number 10 on the list of diagnostic criteria for a substance use disorder, including Cannabis Use Disorder. Just because someone has tolerance to some of marijuana's impairing effects does not make them an addict, since two or more criteria must be fulfilled to earn that diagnosis. A driver who regularly drives while under the influence of THC, and claiming to be tolerant to THC's effects meets criteria #8 and #10 and would therefore be diagnosed at least mildly addicted to THC.

Historically, results of research on the effect of tolerance on driving safety have been varied, with much of the early research confirming that chronic users may show fewer symptoms of impairment than occasional users. However, recent research differs from that conclusion. Let's look at four example conclusions:

> Controlled cannabis smoking impaired psychomotor function, more so in occasional smokers, suggesting some tolerance to psychomotor impairment in frequent users. [69](2009)

> THC significantly impaired performance of occasional cannabis users on critical tracking, divided attention and the stop signal task. THC did not affect the performance of heavy cannabis users except in the stop signal task, i.e. stop reaction time increased, particularly at high THC concentrations. [70] (2009)

> In conclusion, the present study generally confirms that heavy cannabis users develop tolerance to the impairing effects of THC on neurocognitive task performance. [71](2010)

But more recent research contradicts the above:

> Acute effects of cannabis and cocaine on neurocognitive performance were similar across cannabis users irrespective of their cannabis use history. Absence of tolerance implies that that frequent cannabis use and intoxication can be expected to interfere with neurocognitive performance in many daily environments such as school, work or traffic. [72] (2016)

All four of the above statements regarding marijuana tolerance were from the same research team led by Dr. Jan Ramaekers, the author of the JAMA editorial copied in Chapter 1.

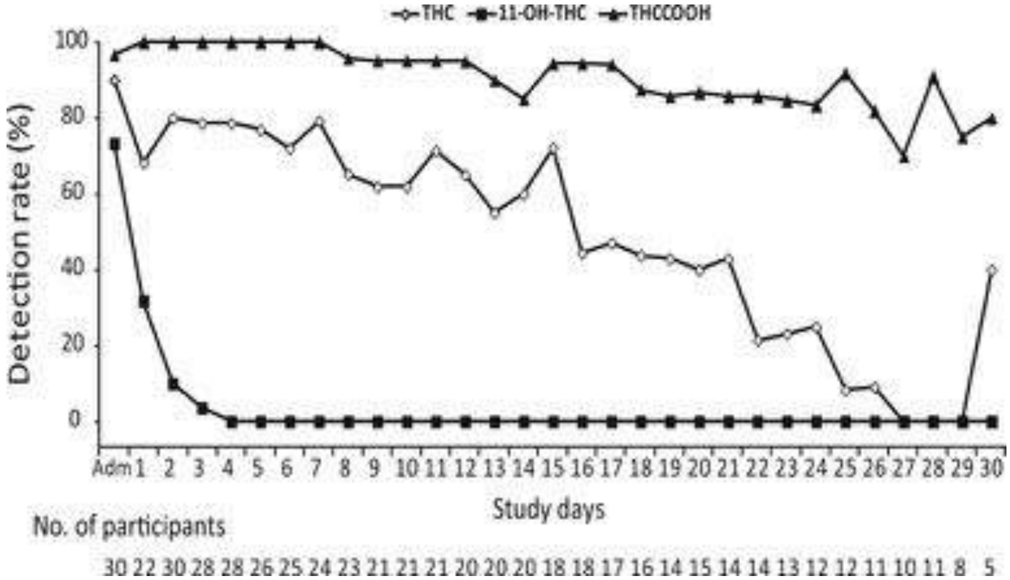
Dr. Ramaekers noted in his 2016 report that earlier studies used sample sizes that were too small to develop statistically robust conclusions. He also followed up on recent research showing chronic users are somewhat chronically impaired, even when they are not acutely impaired:

> Sustained cannabis abstinence moderately improved critical tracking and divided attention performance in chronic, daily cannabis smokers, but impairment was still observable compared to controls after 3 weeks of abstinence. [73] (2013)

Ramaekers found that chronic users, like occasional users, became acutely impaired after dosing with marijuana, but since they have a higher a baseline impairment level due to chronic impairment, the increase in their level of impairment was less than that of occasional users.[74] So by using each subject as his or her own control in the experiment, earlier studies would arrive at the false conclusion that chronic users are less impaired by marijuana than occasional users.

Marijuana users frequently claim that their THC blood level can remain detectable for weeks. This is not true for occasional users as shown by Figures 7 and 8, but can be true for addicts and other heavy users of marijuana. Bergamashi studied 30 chronic marijuana smokers (median nine joints per day) who were kept in a restricted facility with no access to marijuana. He had access to research laboratory techniques that can detect THC down to 0.25 ng/ml, compared to a 1 ng/ml reporting limit for most US forensic laboratories. Although all subjects tested below 1 ng/ml after 7 days, THC in blood could be detected with more sensitive research techniques in some subjects for nearly a month.[75] See Figure 18

Figure 18. Decay of cannabinoids in blood of chronic users



Bergamashi. Clinical Chemistry. 2013

Human variability is one reason research on marijuana tolerance has been so difficult, and why such large numbers are required to do valid research. It has been frequently reported in the literature that some users can compensate for their known impairment by driving more slowly, avoiding merge lanes and passing, and maintaining a greater following distance. Some are even able to pass standardized field sobriety tests. As with anything in life, some are better at it than others.

In summary, tolerance to marijuana's THC is very real but users do not become tolerant to all of its effects. After all, as Chematox's Sarah Ufer asks, "If they did, why would they continue using it?"

Chronic users can either compensate for or become tolerant to some psychomotor tasks, but not to impulsivity tasks.[76] They may not be subject to internal clock speed impairment but they remain impaired to executive function tasks.[77,78] Moreover, executive function impairment is durable, lasting several weeks after consumption.[79]

The normal response of chronic users to subjective tolerance is to simply consume a higher dose to achieve the desired effect as shown on Figure 16. More data will likely emerge to illuminate THC tolerance and its effect on driving, but today there is no conclusive evidence to say that addicts and chronic or heavy marijuana users should be treated any differently than occasional users.

And certainly recent data convinces us that we cannot rely upon anecdotal or small sample reports for "proof" of anything about marijuana and tolerance.

Myths and distortions

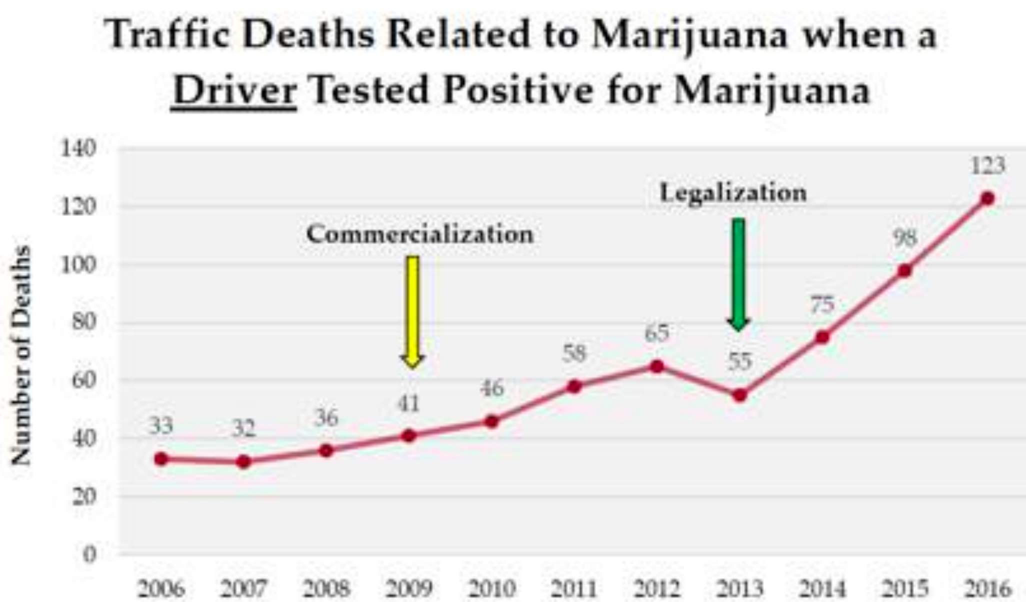
#1 "Marijuana-involved" drivers are not Impaired.

Most reports on marijuana and driving use words like "marijuana-involved" or "marijuana-related" rather than "marijuana-impaired" when describing data trends of drivers testing positive for THC.

Let's look at the facts.

The Rocky Mountain High Intensity Drug Trafficking Area (RMHIDTA) has published an annual report entitled, "The Legalization of Marijuana: The Impact."[80] The first area of study in those reports has been "Impaired Driving and Fatalities." Most of the data used for that portion of the reports comes from the FARS reports or from CDOT that manages the FARS data collection and reporting for Colorado, such as Figure 19.

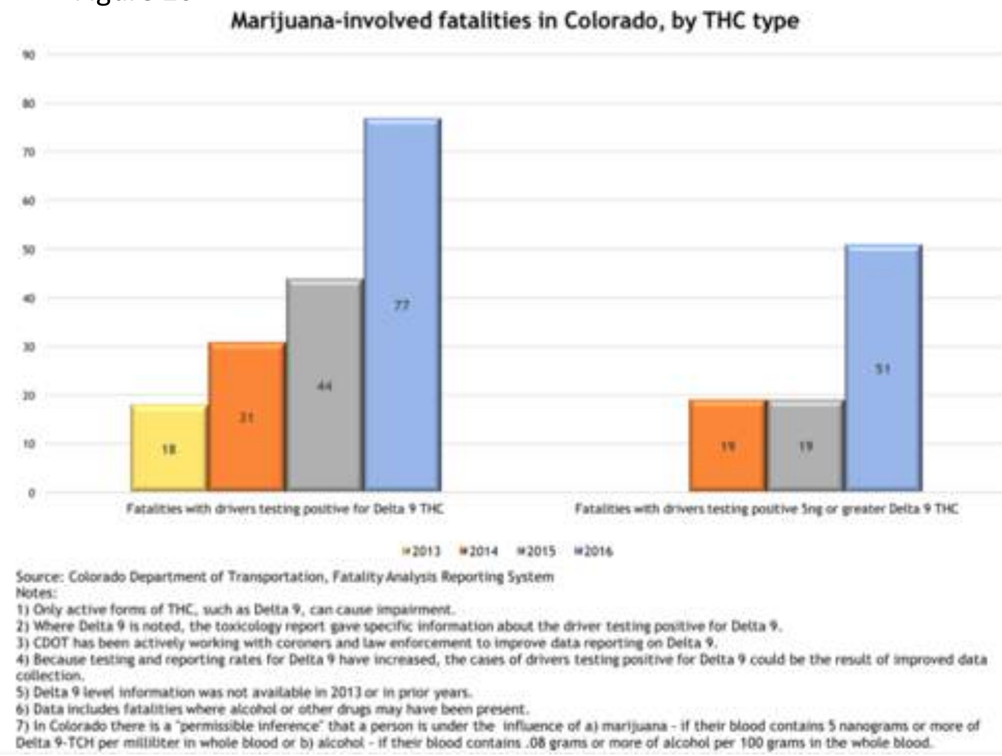
Figure 19



SOURCE: National Highway Traffic Safety Administration, Fatality Analysis Reporting System (FARS), 2006-2011 and Colorado Department of Transportation 2012-2016

Similar information has been published by the Colorado Department of Transportation (CDOT). See Figure 20[81]:

Figure 20



CDPHE 2016

These reports suggest marijuana-impaired crash deaths have more than doubled since legalization, but that's not what the reports actually say. Even though FARS contains toxicology data such as cannabinoid presence in drivers, both RMHIDTA and CDOT are careful to use terms such as "marijuana-related" or "marijuana-involved" when relying upon FARS data, rather than impaired, DUID, or marijuana-caused.

A common belief is they use these terms because someone can be unimpaired with a positive THC level. But there is no experimental proof that this is true. We do have evidence that standard roadside procedures (SFSTs) are only modestly successful in identifying someone impaired by marijuana.[82] So we can claim with confidence that some drivers in the FARS database and others who tested positive for THC perhaps could have passed SFSTs. But we have no evidence that any could have been shown to be unimpaired by laboratory impairment assessments. The scientifically valid reasons for use of "marijuana-involved" or "marijuana-related" are:

1. No data to support DUI charges are included in FARS. Most of the forensic toxicology information included in FARS comes from coroners, and none of their subjects are ever charged with DUI for obvious reasons. Although it is likely that

cannabinoid-positive drivers in FARS reports were impaired, impairment can neither be proven or disproven based solely on the data contained in FARS.

2. FARS reports historically have combined drivers who were positive for THC, the primary impairing substance in marijuana, with drivers who were positive only for THC's inactive metabolite, carboxy-THC. This is a convention prescribed by NHTSA, the organization responsible for managing FARS for nationwide consistency. CDOT has been reporting the number of drivers positive for only THC as shown in Figure 2, but only done so since 2016. Washington State reports also cleanly separate THC from carboxy-THC, and have done so since 2013.
3. FARS collects data on both the *presence* as well as the blood or breath *levels* of alcohol in drivers. For drugs, it collects data only on the presence of a long list of drugs, *not* on their blood levels. Alcohol is treated differently from all other drugs because alcohol is the only drug for which a correlation has been shown between blood levels of drug (alcohol) and the level of impairment caused by the drug (alcohol). Such a correlation does not exist for any other drug, including marijuana. One can infer the levels of impairment of an individual by measuring blood alcohol levels. That cannot be done with any other drug, including marijuana.

The above reasons and other methodological problems led NHTSA to caution against many inferences that have been made about DUID based on FARS reports.[83]

Nevertheless, researchers continue to rely upon FARS simply because it is a large and readily accessible data base. Also FARS provides the largest data set in the US on fatal crashes. For many studies, there are no better alternatives. As a result, many misleading studies have been published.

Fortunately, a better alternative is beginning to emerge with Colorado's HB 17-1315 reports. Rather than inferring DUI information from fatal crash data, the HB17-1315 reports are based upon DUI charges, irrespective of whether or not they resulted in crashes. Past studies that have done this have been based upon much smaller data sets.[84] HB47-1315 reports could be even better if they included not just laboratory results, but also evidence collected by police at the scene of the arrest.

#2 DUID rates are declining in Colorado

The Drug Policy Alliance made this claim, based on the fact that Colorado State Patrol (CSP) DUI citations that noted marijuana as the cause went down 33% from Q1 2016 to Q1 2017. Governor Hickenlooper and AG Coffman made this myth more widespread in their August 2017 response to AG Sessions by claiming, "In the first six months of 2017, the number of drivers the Colorado State Patrol considered impaired by marijuana dropped 21% compared to the first six months of 2016."

Cherry-picking data like the Drug Policy Alliance and Colorado politicians have done doesn't prove much, especially when they pick short-term data. Unfortunately, CSP only began collecting this information since 2014 after a six-month pilot the year before, so we have no long-term pre-legalization or pre-commercialization data to look at. All the CSP data currently available are on Table 12:[85]

Table 12 CSP DUI citations with a marijuana notation on the traffic stop form. No toxicological confirmation.

	2014	**2015**	**2016**	**2017**
Marijuana citations	674	641	780	719
MJ as % of DUI citations	14.6%	13.4%	16.9%	14.8%

Seen graphically, there is a very slight but inconsistent upward trend to citations noting marijuana as the cause. See Figure 21:

Figure 21 – CSP MJ Citations

2014 2015 2016 2017

Colorado State Patrol

The actual year-on-year change for calendar years 2016 and 2017 was an 8% drop, but that was after a 22% increase the year before because of an unusually high number of such citations in Q1 2016. That's far less than the 21% and 33% drop claimed by Governor Hickenlooper and the Drug Policy Alliance.

CSP has historically required all troopers to have ARIDE training before deploying to the field. They changed that policy in 2017 so that ARIDE training would be presented after the trooper had an opportunity to put other basic trooper training into practice. Of course it is not known if delayed ARIDE training affected the slight drop shown in 2017 citations.

#3 Police can't test for marijuana impairment.

Police may use a Preliminary Breath Test (PBT or PAS)) device to establish probable cause to make an arrest when alcohol is suspected, but those results are not admissible in court.

Police may also use an Evidential Breath Test (EBT or EBAT) device, usually at a police station as an alternative to an evidential blood test, but that test is done *after* an arrest has already been made. See Chapter 1, "How DUIs are investigated" for more information.

Driving patterns, such as lane weaving or running a red light form reasonable suspicion that justifies a proactive stop by police. Probable cause is established by impairment assessments which include observations, odor, listening to the driver, and perhaps performing special roadside tests, such as Standardized Field Sobriety Tests (SFSTs). The latter is a battery of three tests for Horizontal Gaze Nystagmus (HGN), Walk and Turn (WAT), and One Leg Stand (OLS). HGN is highly specific for alcohol impairment but not for marijuana impairment. Both WAT and OLS are moderately successful in determining impairment by marijuana[86] but when augmented by Finger To Nose (FTN) and Modified Romberg Balance (MRB) they can be very effective:

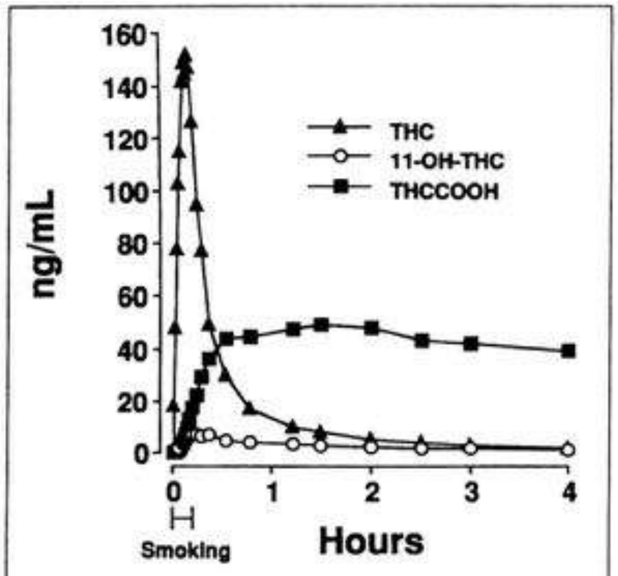
> Requiring ≥2/4 of: ≥3 FTN misses, MRB eyelid tremors, ≥2 OLS clues, and/or ≥2 WAT clues produced the best results (all characteristics ≥96.7%)[87]

#4 Marijuana stays in blood a long time.

Not true. Marijuana can't even get into a driver's blood, much less stay there. It can't. It's a plant. Roots, stems, leaves and all. But some of marijuana's constituents can get into a driver's blood. Using imprecise language like "marijuana" instead of "THC" unfortunately serves to confuse, rather than to illuminate.

THC, otherwise known as delta 9-tetrahydrocannabinol, is the primary psychoactive chemical that does get into a marijuana user's blood stream by smoking, vaping or eating. THC slowly metabolizes to another highly psychoactive metabolite 11-OH-THC, otherwise known as hydroxy-THC. That in turn quickly metabolizes to a psycho-inactive metabolite, 11 nor-9 carboxy-THC also known as THC-COOH, or carboxy-THC. See Figure 22.

Figure 22 – THC vs Carboxy THC[88]



. Mean plasma levels of THC, 11-OH-THC, and THCCOOH during and after smoking a single 3.55% THC marijuana cigarette.

Huestis. J Anal Tox. 1992

THC is not soluble in blood so it is very quickly removed from the bloodstream as it is absorbed by fatty tissues. It is gone from blood within hours in all but addicts and other heavy users.

Carboxy THC is blood-soluble so it remains in the blood for days and even weeks while the THC remaining in the body continues to be metabolized, even though THC may no longer be detectable in blood.

Laboratory tests easily recognize the difference between THC and its inactive metabolite, carboxy-THC.

#5 We need more research before we act.

Research usually has value. Indecisiveness does not.

We can make greater progress by understanding the research that has been done than by waiting for more research. Check out the references in Chapter 9 for a starter.

Do those advocating for more research understand what has already been learned?

States that have no endemic drug use problem have the luxury of waiting for more research. That doesn't apply to Colorado.

Delay in taking action costs lives.

Chapter 4
Understanding contrary reports

With the abundance of research reports being published, it should come as no surprise that some reports contradict each other. Some have already been mentioned in the discussion about marijuana tolerance, for example. Some reports are out-of-date, some are decent science that is badly reported by the media, and some are just poor science. Following are examples of each.

Out-of-date

Robbe HWJ, O'Hanlon JF. Marijuana and Actual Driving Performance. DOT HS 808 078 – 1993

This was a NHTSA-sponsored study studying the effects of three doses of THC taken alone or combined with enough alcohol to achieve a BAC of .04. Driving was tested on instrumented cars on roads in the Netherlands with accompanying driving instructors. The doses of 100, 200, and 300 μgm/Kg THC were produced with NHTSA-provided marijuana of 1.75% and 3.57% THC.

The authors concluded, “Drivers under the influence of marijuana retain insight in their performance and will compensate where they can, for example, by slowing down or increasing effort. As a consequence, THC’s adverse effects on driving performance appear relatively small.”

Hindrik WJ, Robbe HWJ, O'Hanlon JF. Marijuana Alcohol and Actual Driving Performance. NHTSA DOT HS 808 939 – 1999

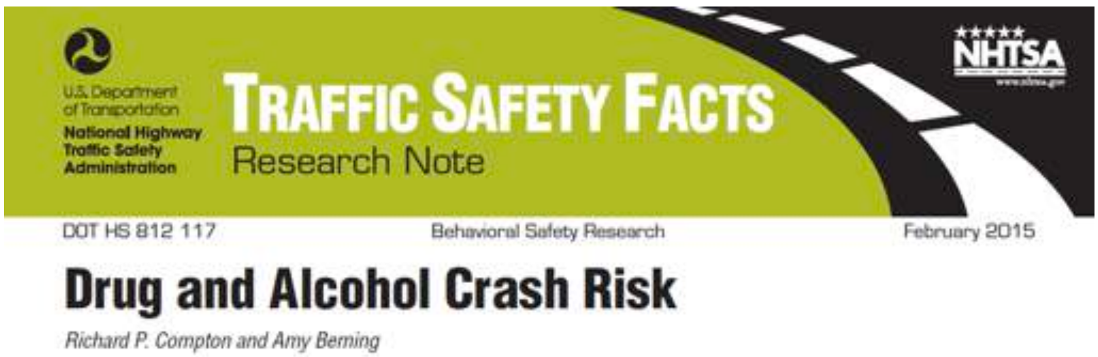
Six years later the same authors repeated the study, this time with slightly higher THC content marijuana: 2.2% and 3.95%.

The authors concluded, “In a previous series of studies on the effects of THC alone we concluded that THC given in doses up to 300 μgm/Kg has ‘slight’ effects on driving performance. The results of the present study now compel us to revise that conclusion. The present subjects’ performance was more affected than their predecessors’.”

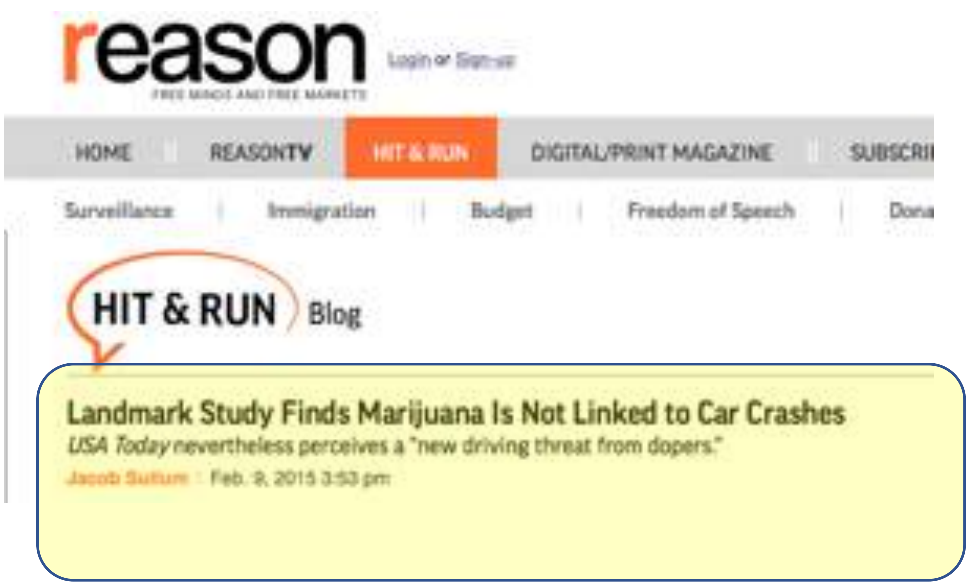
A word about dose vs. THC content. To achieve a 300 μgm/Kg dose, subjects had to consume 2-3 joints with the THC potency available at the time. Normal potency today is at least five times the potency available for research in 1993 and 1999.

Badly reported by the media

Compton RP, Berning A. Drug and Alcohol Crash Risk. NHTSA Traffic Safety Facts Research Note DOT HS 812 117 – 2015



This was a NHTSA-sponsored study of 3,095 drivers in 2,682 crashes in Virginia Beach. A summary of the report was released February 2015, followed three days later by a media blitz that misquoted the research (highlight below is added):



Reason's interpretation of the study has been widely spread by the marijuana-friendly media, even by such supposedly neutral outlets like FactCheck.org as recently as December, 2017[89]. *USA Today* said, "New study shows no link between marijuana use and car accidents." *The Los Angeles Times* said, "Good news (?): marijuana doesn't increase the likelihood of car crashes."

The popular media coverage of the study was completely false. First of all, it's true that the study failed to find a statistically significant link between crashes and marijuana use. But a failure to find a link not the same thing as finding there is no link. Just like your failure to find your car keys does not prove that the keys no longer exist.

When you can't find your car keys, it's because you didn't look where they were. In this case, NHTSA failed to find a link because the study was not designed to find a link.

But the important point is that the study also failed to find a statistically significant link between crash risk and the use of <u>any</u> drug: cocaine, methamphetamines, opioids, or any combinations of those drugs, all of which are even more impairing than marijuana. They couldn't find significant links simply because the study was flawed for the following reasons:

1. The sample size was too small to find a statistically significant link for many of the drugs, because of the low baseline prevalence of use of some drugs and odds ratios for fatal crashes for drugs.
2. This was a case-controlled quasi-epidemiological study with a justifiably highly-regarded control selection. Unfortunately, the selection of study subjects was not of similar quality. Unlike a true epidemiological study, this did not include observations of all subjects in the study pool, but only those who volunteered to be studied. It's unclear why a subject who knew he or she was impaired would volunteer to be part of the study, and indeed, many subjects in the study chose not to volunteer to have their data collected. We cannot know what their inclusion might have done to the final statistics.
3. At least 413 of the test subjects were innocent victims who were involved in the crash, but did not cause the crash. All other things being equal, one might expect that the prevalence of drugs in victims would be no different than that of controls. By including the innocent victims of the crash into the test subject pool, NHTSA diluted the results of those who caused of the crash. This is material when one realizes that the OR for crash fatalities due to marijuana is only about 2. Diluting the data with innocent, unimpaired victims would lower it even further.
4. NHTSA earlier published strong data showing that the OR for a non-fatal crash is less than that for a fatal crash.[90] But in the Virginia Beach study there were only 15 fatalities, which limits the usefulness of the findings.
5. Virginia Beach was a convenient locale to do a study because of cooperation from the local law enforcement. But being a military town, it hardly represents drug havens across the rest of America, especially Colorado. Controls in Virginia Beach showed a 14.4% prevalence of drugs compared to a 19-22% prevalence in the 2014 NHTSA National Roadside Survey, depending upon assay and time of day.

Finally, look at the conclusion of the published study, "This study should not be interpreted to mean that it is safe for individuals who have used substances to operate a vehicle." Yet that's exactly what Reason magazine and most of the rest of the news media did back then, and many are still doing today.

Bad science #1

Aydelotte JD, Brown LH, Luftman KM et al. Crash fatality rates after recreational marijuana legalization in Washington and Colorado. Am J Public Health (Aug 2017) 107 (8) 1329-1331

Jayson Aydelotte, a trauma surgeon at U of Texas in Austin concluded in his study published in the American Journal of Public Health, "Three years after recreational marijuana legalization, changes in motor vehicle crash fatality rates for Washington and Colorado were not statistically different from those in similar states without recreational marijuana legalization."[91]

This report has been widely embraced by the marijuana lobby, even though the article estimated that, using FARS data, the fatality rate *increased* in Colorado and Washington during the study periods, whereas they *dropped* in the comparison states. After adjusting the data, the authors estimated that there were 77 "excess crash fatalities" in Colorado and Washington since marijuana legalization. The authors felt this number was not significant, but admitted, "others might disagree."

Presumably the 77 "excess crash fatalities" would disagree had they survived.

This report has been criticized, noting that "total traffic fatalities" is a blunt tool to measure the impact of marijuana legalization.[92] See annotated bibliography #54 in Chapter 9 for more.

Bad science #2

Anderson DM, Hansen B, Rees DI. Medical Marijuana Laws, Traffic Fatalities and Alcohol Consumption. – 2012

Mark Anderson and Daniel Rees used FARS and "total traffic fatalities" to arrive at the conclusion that, "The first full year after coming into effect, legalization is associated with an 8 to 11 percent decrease in traffic fatalities." The authors theorized that the availability of marijuana reduced alcohol consumption which then drove down total traffic fatalities, "We conclude that alcohol is the likely mechanism through which the legalization of medical marijuana reduces traffic fatalities."[93]

This paper has the same basic flaw as the immediately preceding paper – it uses "total traffic fatalities" as a very blunt tool to measure the impact of marijuana legalization. There is no doubt that traffic fatalities fell in those states. During the periods studied, traffic fatalities were falling all across the country for many reasons have nothing to do with marijuana. See Figure 5 in Chapter 2. Most states had drops of traffic fatalities greater than those who legalized medical marijuana, but for reasons that had little to nothing to do with marijuana.

Contrary to the author's conjecture, the Colorado Department of Revenue reports a continuous rise in excise tax revenue from liquor sales.

This study doesn't even qualify as bad science, but is routinely quoted by marijuana supporters.

Part Two - References

Relevant DUI/DUID Colorado statutes

State-by-state comparison of DUI laws

Proposals of model DUID policies – the national perspective

Governors Highway Safety Association (GHSA)

Institute for Behavior and Health

European Transport Safety Council

National Highway Traffic Safety Administration

Heritage Foundation

DUID Victim Voices and We Save Lives

Driving High Means DUI coalition

Chapter 5
Relevant DUI/DUID Colorado laws

42-2-126	Revocation of license – ALR
42-4-1301	DUI, DWAI, DUI *per se*, definitions, penalties
42-4-1301.1	Expressed consent
42-4-1301.3	Alcohol and drugged driving safety program
42-4-1302	Stopping of suspect
42-4-1303	Records – *prima facie* proof
42-4-1304	Biological samples – CDPHE duties
42-4-1305	Open beverage container
42-4-1305.5	Open marijuana container
42-4-1307	Penalties – alcohol and drug traffic offenses
42-4-1601	Crashes involving death or SBI – duties
18-3-106	Vehicular homicide
18-3-205	Vehicular assault

§ 42-2-126. Revocation of license based on administrative determination

(1) Legislative declaration. The purposes of this section are:

(a) To provide safety for all persons using the highways of this state by quickly revoking the driver's license of any person who has shown himself or herself to be a safety hazard by driving with an excessive amount of alcohol in his or her body and any person who has refused to submit to an analysis as required by section 42-4-1301.1;

(b) To guard against the potential for any erroneous deprivation of the driving privilege by providing an opportunity for a full hearing; and

(c) Following the revocation period, to prevent the relicensing of a person until the department is satisfied that the person's alcohol problem is under control and that the person no longer constitutes a safety hazard to other highway users.

(2) Definitions. As used in this section, unless the context otherwise requires:

(a) "Excess BAC" means that a person had a BAC level sufficient to subject the person to a license revocation for excess BAC 0.08, excess BAC underage, excess BAC CDL, or excess BAC underage CDL.

(b) "Excess BAC 0.08" means that a person drove a vehicle in this state when the person's BAC was 0.08 or more at the time of driving or within two hours after driving.

(c) "Excess BAC CDL" means that a person drove a commercial motor vehicle in this state when the person's BAC was 0.04 or more at the time of driving or at any time thereafter.

(d) "Excess BAC underage" means that a person was under the age of twenty-one years and the person drove a vehicle in this state when the person's BAC was in excess of 0.02 but less than 0.08 at the time of driving or within two hours after driving.

(e) "Excess BAC underage CDL" means that a person was under the age of twenty-one years and the person drove a commercial motor vehicle in this state when the person's BAC was in excess of 0.02 but less than 0.04 at the time of driving or at any time thereafter.

(f) "Hearing officer" means the executive director of the department or an authorized representative designated by the executive director.

(g) "License" includes driving privilege.

(h) "Refusal" means refusing to take or complete, or to cooperate in the completing of, a test of the person's blood, breath, saliva, or urine as required by section 18-3-106 (4) or 18-3-205 (4), C.R.S., or section 42-4-1301.1 (2).

(i) "Respondent" means a person who is the subject of a hearing under this section.

(3) Revocation of license.

(a) Excess BAC 0.08.

(I) The department shall revoke the license of a person for excess BAC 0.08 for:

(A) Nine months for a first violation committed on or after January 1, 2009; except that such a person may apply for a restricted license pursuant to the provisions of section 42-2-132.5;

(B) One year for a second violation; and

(C) Two years for a third or subsequent violation occurring on or after January 1, 2009, regardless of when the prior violations occurred; except that such a person may apply for a restricted license pursuant to the provisions of section 42-2-132.5.

(II) (Deleted by amendment, L. 2008, p. 833, § 3, effective January 1, 2009.)

(b) Excess BAC underage.

(I) The department shall revoke the license of a person for excess BAC underage for three months for a first violation, for six months for a second violation, and for one year for a third or subsequent violation.

(II)

(A) Notwithstanding the provisions of subparagraph (I) of this paragraph (b), a person whose license is revoked for a first offense under subparagraph (I) of this paragraph (b) and whose BAC was not more than 0.05 may request that, in lieu of the three-month revocation, the person's license be revoked for a period of not less than thirty days, to be followed by a suspension period of such length that the total period of revocation and suspension equals three months. If the hearing officer approves the request, the hearing officer may grant the person a probationary license that may be used only for the reasons provided in section 42-2-127 (14)(a).

(B) The hearing to consider a request under this subparagraph (II) may be held at the same time as the hearing held under subsection (8) of this section; except that a probationary license may not become effective until at least thirty days have elapsed since the beginning of the revocation period.

(c) Refusal.

(I) Except as provided in section 42-2-132.5 (4), the department shall revoke the license of a person for refusal for one year for a first violation, two years for a second violation, and three years for a third or subsequent violation; except that the period of revocation shall be at least three years if the person was driving a commercial motor vehicle that was transporting hazardous materials as defined in section 42-2-402 (7).

(II) Notwithstanding the provisions of subparagraph (I) of this paragraph (c), such a person whose license has been revoked for two years for a second violation or for three years for a third or subsequent violation may apply for a restricted license pursuant to the provisions of section 42-2-132.5.

(d) Excess BAC CDL. The department shall revoke for the disqualification period provided in 49 CFR 383.51 the commercial driving privilege of a person who was the holder of a commercial driver's license or was driving a commercial motor vehicle for a violation of excess BAC 0.08, excess BAC CDL, or refusal.

(e) Excess BAC underage CDL. The department shall revoke the commercial driving privilege of a person for excess BAC underage CDL for three months for a first violation, six months for a second violation, and one year for a third or subsequent violation.

(4) Multiple restraints and conditions on driving privileges.

(a)

(I) Except as otherwise provided in this paragraph (a), a revocation imposed pursuant to this section for an offense committed before January 1, 2014, shall run consecutively and not concurrently with any other revocation imposed pursuant to this section.

(II) If a license is revoked for excess BAC and the person is also convicted on criminal charges arising out of the same occurrence for DUI, DUI per se, DWAI, or UDD, both the revocation under this section and any suspension, revocation, cancellation, or denial that results from the conviction shall be imposed, but the periods shall run concurrently, and the total period of revocation, suspension, cancellation, or denial shall not exceed the longer of the two periods.

(III)

(A) If a license is revoked for refusal for an offense committed before January 1, 2014, the revocation shall not run concurrently, in whole or in part, with any previous or subsequent suspensions, revocations, or denials that may be provided for by law, including but not limited to any suspension, revocation, or denial that results from a conviction of criminal charges arising out of the same occurrence for a violation of section 42-4-1301.

(B) If a license is revoked for refusal for an offense committed on or after January 1, 2014, and the person is also convicted on criminal charges arising out of the same occurrence for DUI, DUI per se, DWAI, or UDD, both the revocation under this section and any suspension, revocation, cancellation, or denial that results from the conviction shall be imposed, but the periods shall run concurrently. The total period of revocation, suspension, cancellation, or denial shall not exceed the longer of the two periods.

(IV) The revocation of the commercial driving privilege under excess BAC CDL may run concurrently with another revocation pursuant to this section arising out of the same incident.

(V) Any revocation for refusal shall not preclude other action that the department is required to take in the administration of this title.

(b)

(I) The periods of revocation specified in subsection (3) of this section are intended to be minimum periods of revocation for the described conduct. Except as described in section 42-2-132.5, a license shall not be restored under any circumstances, and a probationary license shall not be issued, during the revocation period.

(II) Notwithstanding the provisions of subparagraph (I) of this paragraph (b), a person whose privilege to drive a commercial motor vehicle has been revoked because of excess BAC CDL and who was twenty-one years of age or older at the time of the offense may apply for a driver's license of another class or type as long as there is no other statutory reason to deny the person a license. The department may not issue the person a probationary license that would authorize the person to operate a commercial motor vehicle.

(c) Upon the expiration of the period of revocation under this section, if a person's license is still suspended on other grounds, the person may seek a probationary license as authorized by section 42-2-127 (14) subject to the requirements of paragraph (d) of this subsection (4).

(d)

(I) Following a license revocation, the department shall not issue a new license or otherwise restore the driving privilege unless the department is satisfied, after an investigation of the character, habits, and driving ability of the person, that it will be safe to grant the privilege of driving a motor vehicle on the highways to the person; except that the department may not require a person to undergo skills or knowledge testing prior to issuance of a new license or restoration of the person's driving privilege if the person's license was revoked for a first violation of excess BAC 0.08 or excess BAC underage.

(II)

(A) If a person was driving with excess BAC and the person had a BAC that was 0.15 or more or if the person's driving record otherwise indicates a designation as a persistent drunk driver as defined in section 42-1-102 (68.5), the department shall require the person to complete a level II alcohol and drug education and treatment program certified by the office of behavioral health in the department of human services pursuant to section 42-4-1301.3 as a condition to restoring driving privileges to the person and, upon the restoration of driving privileges, shall require the person to hold a restricted license requiring the use of an ignition interlock device pursuant to section 42-2-132.5 (1)(a)(II).

(B) If a person seeking reinstatement is required to complete, but has not yet completed, a level II alcohol and drug education and treatment program, the person shall file with the department proof of current enrollment in a level II alcohol and drug education and treatment program certified by the office of behavioral health in the department of human services pursuant to section 42-4-1301.3, on a form approved by the department.

(5) Actions of law enforcement officer.

(a) If a law enforcement officer has probable cause to believe that a person should be subject to license revocation for excess BAC or refusal, the law enforcement officer shall forward to the department an affidavit containing information relevant to the legal issues and facts that shall be considered by the department to determine whether the person's license should be revoked as provided in subsection (3) of this section. The executive director of the department shall specify to law enforcement agencies the form of the affidavit to be used under this paragraph (a) and the types of information needed in the affidavit and may specify any additional documents or copies of documents needed by the department to make its determination in addition to the affidavit. The affidavit shall be dated, signed, and sworn to by the law enforcement officer under penalty of perjury, but need not be notarized or sworn to before any other person.

(b)

(I) A law enforcement officer, on behalf of the department, shall personally serve a notice of revocation on a person who is still available to the law enforcement officer if the law enforcement officer determines that, based on a refusal or on test results available to the law enforcement officer, the person's license is subject to revocation for excess BAC or refusal.

(II) When a law enforcement officer serves a notice of revocation, the law enforcement officer shall take possession of any driver's license issued by this state or any other state that the person holds. When the law enforcement officer takes possession of a valid driver's license issued by this state or any other state, the law enforcement officer, acting on behalf of the department, shall issue a temporary permit that is valid for seven days after the date of issuance.
(III) A copy of the completed notice of revocation form, a copy of any completed temporary permit form, and any driver's, minor driver's, or temporary driver's license or any instruction permit taken into possession under this section shall be forwarded to the department by the law enforcement officer along with an affidavit as described in paragraph (a) of this subsection (5) and any additional documents or copies of documents as described in said paragraph (a).
(IV) The department shall provide to law enforcement agencies forms for notice of revocation and for temporary permits. The law enforcement agencies shall use the forms for the notice of revocation and for temporary permits and shall follow the form and provide the information for affidavits as provided by the department pursuant to paragraph (a) of this subsection (5).
(V) A law enforcement officer shall not issue a temporary permit to a person who is already driving with a temporary permit issued pursuant to subparagraph (II) of this paragraph (b).

(6) Initial determination and notice of revocation.

(a) Upon receipt of an affidavit of a law enforcement officer and the relevant documents required by paragraph (a) of subsection (5) of this section, the department shall determine whether the person's license should be revoked under subsection (3) of this section. The determination shall be based upon the information contained in the affidavit and the relevant documents submitted to the department, and the determination shall be final unless a hearing is requested and held as provided in subsection (8) of this section. The determination of these facts by the department is independent of the determination of a court of the same or similar facts in the adjudication of any criminal charges arising out of the same occurrence. The disposition of the criminal charges shall not affect any revocation under this section.

(b)

(I) If the department determines that the person is subject to license revocation, the department shall issue a notice of revocation if a notice has not already been served upon the person by the law enforcement officer as provided in paragraph (b) of subsection (5) of this section. A notice of revocation shall clearly specify the reason and statutory grounds for the revocation, the effective date of the revocation, the right of the person to request a hearing, the procedure for requesting a hearing, and the date by which a request for a hearing must be made.
(II) In sending a notice of revocation, the department shall mail the notice in accordance with the provisions of section 42-2-119 (2) to the person at the last-known address shown on the department's records, if any, and to any address provided in the law enforcement officer's affidavit if that address differs from the address of record. The notice shall be deemed received three days after mailing.

(c) If the department determines that the person is not subject to license revocation, the department shall notify the person of its determination and shall rescind any order of revocation served upon the person by the law enforcement officer.

(d) A license revocation shall become effective seven days after the person has received the notice of revocation as provided in subsection (5) of this section or is deemed to have received the notice of revocation by mail as provided in paragraph (b) of this subsection (6). If the department receives a written request for a hearing pursuant to subsection (7) of this section within that same seven-day period and the department issues a temporary permit pursuant to paragraph (d) of subsection (7) of this section, the effective date of the revocation shall be stayed until a final order is issued following the hearing; except that any delay in the hearing that is caused or requested by the person or counsel representing the person shall not result in a stay of the revocation during the period of delay.

(7) Request for hearing.

(a) A person who has received a notice of revocation may make a written request for a review of the department's determination at a hearing. The request may be made on a form available at each office of the department.

(b) A person must request a hearing in writing within seven days after the day the person receives the notice of revocation as provided in subsection (5) of this section or is deemed to have received the notice by mail as provided in paragraph (b) of subsection (6) of this section. If the department does not receive the written request for a hearing within the seven-day period, the right to a hearing is waived, and the determination of the department that is based on the documents and affidavit required by subsection (5) of this section becomes final.

(c) If a person submits a written request for a hearing after expiration of the seven-day period and if the request is accompanied by the person's verified statement explaining the failure to make a timely request for a hearing, the department shall receive and consider the request. If the department finds that the person was unable to make a timely request due to lack of actual notice of the revocation or due to factors of physical incapacity such as hospitalization or incarceration, the department shall waive the period of limitation, reopen the matter, and grant the hearing request. In such a case, the department shall not grant a stay of the revocation pending issuance of the final order following the hearing.

(d) At the time a person requests a hearing pursuant to this subsection (7), if it appears from the record that the person is the holder of a valid driver's or minor driver's license or of an instruction permit or of a temporary permit issued pursuant to paragraph (b) of subsection (5) of this section and that the license or permit has been surrendered, the department shall stay the effective date of the revocation and issue a temporary permit that shall be valid until the scheduled date for the hearing. If necessary, the department may later extend the temporary permit or issue an additional temporary permit in order to stay the effective date of the revocation until the final order is issued following the hearing, as required by subsection (8) of this section. If the person notifies the department in writing at the time that the hearing is requested that the person desires the law enforcement officer's presence at the hearing, the department shall issue a written notice for the law enforcement officer to appear at the hearing. A law enforcement officer who is required to appear at a hearing may, at the discretion of the hearing officer, appear in real time by telephone or other electronic means in accordance with section 42-1-218.5.

(e) At the time that a person requests a hearing, the department shall provide to the person written notice advising the person:

(I) Of the right to subpoena the law enforcement officer for the hearing and that the subpoena must be served upon the law enforcement officer at least five calendar days prior to the hearing;

(II) Of the person's right at that time to notify the department in writing that the person desires the law enforcement officer's presence at the hearing and that, upon receiving the notification, the department shall issue a written notice for the law enforcement officer to appear at the hearing;

(III) That, if the law enforcement officer is not required to appear at the hearing, documents and an affidavit prepared and submitted by the law enforcement officer will be used at the hearing; and

(IV) That the affidavit and documents submitted by the law enforcement officer may be reviewed by the person prior to the hearing.

(f) Any subpoena served upon a law enforcement officer for attendance at a hearing conducted pursuant to this section shall be served at least five calendar days before the day of the hearing.

(8) Hearing.

(a)

(I) The hearing shall be scheduled to be held as quickly as practicable but not more than sixty days after the date the department receives the request for a hearing; except that, if a hearing is rescheduled because of the unavailability of a law enforcement officer or the hearing officer in accordance with subsection (8)(a)(III) or (8)(a)(IV) of this section, the hearing may be rescheduled more than sixty days after the date the department receives the request for the hearing, and the department shall continue any temporary driving privileges held by the person until the date to which the hearing is rescheduled. At least ten days prior to the scheduled or rescheduled hearing, the department shall provide in the manner specified in section 42-2-119 (2) a written notice of the time and place of the hearing to the respondent unless the parties agree to waive this requirement. Notwithstanding the provisions of sections 42-1-102 and 42-2-119, the last-known address of the respondent for purposes of notice for any hearing pursuant to this section is the address stated on the hearing request form.

(II) A law enforcement officer who submits the documents and affidavit required by subsection (5) of this section need not be present at the hearing unless the hearing officer requires that the law enforcement officer be present and the hearing officer issues a written notice for the law enforcement officer's appearance or unless the respondent or the respondent's attorney determines that the law enforcement officer should be present and serves a timely subpoena upon the law enforcement officer in accordance with paragraph (f) of subsection (7) of this section.

(III) If a law enforcement officer, after receiving a notice or subpoena to appear from either the department or the respondent, is unable to appear at the original or rescheduled hearing date due to a reasonable conflict, including but not limited to training, vacation, or personal leave time, the law enforcement officer or the law enforcement officer's supervisor shall contact the department not less than forty-eight hours prior to the hearing and reschedule the hearing to a time when the law enforcement officer will be available. If the law enforcement officer cannot appear at the original or rescheduled hearing because of medical reasons, a law enforcement emergency, another court or administrative hearing, or any other legitimate, just cause as determined by the department, and the law enforcement officer or the law enforcement officer's supervisor gives notice of the law enforcement officer's inability to appear to the department prior to the dismissal of the revocation proceeding, the department shall reschedule the hearing following consultation with the law enforcement officer or the law enforcement officer's supervisor at the earliest possible time when the law enforcement officer and the hearing officer will be available.

(IV) If a hearing officer cannot appear at an original or rescheduled hearing because of medical reasons, a law enforcement emergency, another court or administrative hearing, or any other legitimate, just cause, the hearing officer or the department may reschedule the hearing at the earliest possible time when the law enforcement officer and the hearing officer will be available.

(b) The hearing shall be held in the district office nearest to where the violation occurred, unless the parties agree to a different location; except that, at the discretion of the department, all or part of the hearing may be conducted in real time, by telephone or other electronic means in accordance with section 42-1-218.5.

(c) The department shall consider all relevant evidence at the hearing, including the testimony of any law enforcement officer and the reports of any law enforcement officer that are submitted to the department. The report of a law enforcement officer shall not be required to be made under oath, but the report shall identify the law enforcement officer making the report. The department may consider evidence contained in affidavits from persons other than the respondent, so long as the affidavits include the affiant's home or work address and phone number and are dated, signed, and sworn to by the affiant under penalty of perjury. The affidavit need not be notarized or sworn to before any other person.

(d) The hearing officer shall have authority to:

(I) Administer oaths and affirmations;

(II) Compel witnesses to testify or produce books, records, or other evidence;

(III) Examine witnesses and take testimony;

(IV) Receive and consider any relevant evidence necessary to properly perform the hearing officer's duties as required by this section;

(V) Take judicial notice as defined by rule 201 of article II of the Colorado rules of evidence, subject to the provisions of section 24-4-105 (8), C.R.S., which shall include:

(A) Judicial notice of general, technical, or scientific facts within the hearing officer's knowledge;

(B) Judicial notice of appropriate and reliable scientific and medical information contained in studies, articles, books, and treatises; and

(C) Judicial notice of charts prepared by the department of public health and environment pertaining to the maximum BAC levels that people can obtain through the consumption of alcohol when the charts are based upon the maximum absorption levels possible of determined amounts of alcohol consumed in relationship to the weight and gender of the person consuming the alcohol;

(VI) Issue subpoenas duces tecum to produce books, documents, records, or other evidence;

(VII) Issue subpoenas for the attendance of witnesses;

(VIII) Take depositions or cause depositions or interrogatories to be taken;

(IX) Regulate the course and conduct of the hearing; and

(X) Make a final ruling on the issues.

(e) When an analysis of the respondent's BAC is considered at a hearing:

(I) If the respondent establishes, by a preponderance of the evidence, that the respondent consumed alcohol between the time that the respondent stopped driving and the time of testing, the preponderance of the evidence must also establish that the minimum required BAC was reached as a result of alcohol consumed before the respondent stopped driving; and

(II) If the evidence offered by the respondent shows a disparity between the results of the analysis done on behalf of the law enforcement agency and the results of an analysis done on behalf of the respondent, and a preponderance of the evidence establishes that the blood analysis conducted on behalf of the law enforcement agency was properly conducted by a qualified person associated with a laboratory certified by the department of public health and environment using properly working testing devices, there shall be a presumption favoring the accuracy of the analysis done on behalf of the law enforcement agency if the analysis showed the BAC to be 0.096 or more. If the respondent offers evidence of blood analysis, the respondent shall be required to state under oath the number of analyses done in addition to the one offered as evidence and the names of the laboratories that performed the analyses and the results of all analyses.

(f) The hearing shall be recorded. The hearing officer shall render a decision in writing, and the department shall provide a copy of the decision to the respondent.

(g) If the respondent fails to appear without just cause, the right to a hearing shall be waived, and the determination of the department which is based upon the documents and affidavit required in subsection (5) of this section shall become final.

(h) Pursuant to section 42-1-228, a driver may challenge the validity of the law enforcement officer's initial contact with the driver and the driver's subsequent arrest for DUI, DUI per se, or DWAI. If a driver so challenges the validity of the law enforcement officer's initial contact, and the evidence does not establish that the initial contact or arrest was constitutionally and statutorily valid, the driver is not subject to license revocation.

(9) Appeal.

(a) Within thirty-five days after the department issues its final determination under this section, a person aggrieved by the determination has the right to file a petition for judicial review in the district court in the county of the person's residence.

(b) Judicial review of the department's determination shall be on the record without taking additional testimony. If the court finds that the department exceeded its constitutional or statutory authority, made an erroneous interpretation of the law, acted in an arbitrary and capricious manner, or made a determination that is unsupported by the evidence in the record, the court may reverse the department's determination.

(c) A filing of a petition for judicial review shall not result in an automatic stay of the revocation order. The court may grant a stay of the order only upon a motion and hearing and upon a finding that there is a reasonable probability that the person will prevail upon the merits.

(10) Notice to vehicle owner. If the department revokes a person's license pursuant to paragraph (a), (c), or (d) of subsection (3) of this section, the department shall mail a notice to the owner of the motor vehicle used in the violation informing the owner that:

(a) The motor vehicle was driven in an alcohol-related driving violation; and

(b) Additional alcohol-related violations involving the motor vehicle by the same driver may result in a requirement that the owner file proof of financial responsibility under the provisions of section 42-7-406 (1.5).

(11) Applicability of "State Administrative Procedure Act". The "State Administrative Procedure Act", article 4 of title 24, C.R.S., shall apply to this section to the extent it is consistent with subsections (7), (8), and (9) of this section relating to administrative hearings and judicial review.

§ 42-4-1301 Driving under the influence--driving while impaired--driving with excessive alcoholic content--definitions--penalties

(1)

(a) A person who drives a motor vehicle or vehicle under the influence of alcohol or one or more drugs, or a combination of both alcohol and one or more drugs, commits **driving under the influence**. Driving under the influence is a misdemeanor, but it is a class 4 felony if the violation occurred after three or more prior convictions, arising out of separate and distinct criminal episodes, for DUI, DUI per se, or DWAI; vehicular homicide, as described in section 18-3-106(1)(b), C.R.S .; vehicular assault, as described in section 18-3-205(1)(b), C.R.S .; or any combination thereof.

(b) A person who drives a motor vehicle or vehicle while impaired by alcohol or by one or more drugs, or by a combination of alcohol and one or more drugs, commits **driving while ability impaired**. Driving while ability impaired is a misdemeanor, but it is a class 4 felony if the violation occurred after three or more prior convictions, arising out of separate and distinct criminal episodes, for DUI, DUI per se, or DWAI; vehicular homicide, as described in section 18-3-106(1)(b), C.R.S .; vehicular assault, as described in section 18-3-205(1)(b), C.R.S .; or any combination thereof.

(c) Repealed by Laws 2013, Ch. 331, § 1, eff. May 28, 2013.

(d) As used in this section, one or more drugs means any drug, as defined in section 27-80-203(13), C.R.S ., any controlled substance, as defined in section 18-18-102(5), C.R.S ., and any inhaled glue, aerosol, or other toxic vapor or vapors, as defined in section 18-18-412, C.R.S .

(e) The fact that any person charged with a violation of this subsection (1) is or has been entitled to use one or more drugs under the laws of this state, including, but not limited to, the medical use of marijuana pursuant to section 18-18-406.3, C.R.S ., shall not constitute a defense against any charge of violating this subsection (1).

(f) “Driving under the influence” means driving a motor vehicle or vehicle when a person has consumed alcohol or one or more drugs, or a combination of alcohol and one or more drugs, that affects the person to a degree that the person is substantially incapable, either mentally or physically, or both mentally and physically, to exercise clear judgment, sufficient physical control, or due care in the safe operation of a vehicle.

(g) “Driving while ability impaired” means driving a motor vehicle or vehicle when a person has consumed alcohol or one or more drugs, or a combination of both alcohol and one or more drugs, that affects the person to the slightest degree so that the person is less able than the person ordinarily would have been, either mentally or physically, or both mentally and physically, to exercise clear judgment, sufficient physical control, or due care in the safe operation of a vehicle.

(h) Pursuant to section 16-2-106, C.R.S ., in charging the offense of DUI, it shall be sufficient to describe the offense charged as “drove a vehicle under the influence of alcohol or drugs or both”.

(i) Pursuant to section 16-2-106, C.R.S ., in charging the offense of DWAI, it shall be sufficient to describe the offense charged as “drove a vehicle while impaired by alcohol or drugs or both”.

(j) For the purposes of this section, a person is deemed to have a prior conviction for DUI, DUI per se, or DWAI; vehicular homicide, as described in section 18-3-106(1)(b), C.R.S .; or vehicular assault, as described in section 18-3-205(1)(b), C.R.S ., if the person has been convicted under the laws of this state or under the laws of any other state, the United States, or any territory subject to the jurisdiction of the United States, of an act that, if committed within this state, would constitute any of these offenses. The prosecution shall set forth such prior convictions in the indictment or information.

(k)

(I) If a defendant is convicted of a class 4 felony pursuant to this section, the court shall sentence the person in accordance with the provisions of section 18-1.3-401, C.R.S .

(II)

(A) Notwithstanding the provisions of subparagraph (I) of this paragraph (k), before the imposition of any sentence to the department of corrections for a felony DUI, DUI per se, or DWAI offense, at sentencing or at resentencing after a revocation of probation or a community corrections sentence, the court shall consider all the factors described in sub-subparagraph (B) of this subparagraph (II).

(B) If the court sentences the defendant to the department of corrections for a felony DUI, DUI per se, or DWAI offense, it must determine that incarceration is the most suitable option given the facts and circumstances of the case, including the defendant's willingness to participate in treatment. Additionally, the court shall consider whether all other reasonable and appropriate sanctions and responses to the violation that are available to the court have been exhausted, do not appear likely to be successful if tried, or present an unacceptable risk to public safety.

(2)

(a) A person who drives a motor vehicle or vehicle when the person's BAC is 0.08 or more at the time of driving or within two hours after driving commits DUI per se. During a trial, if the state's evidence raises the issue, or if a defendant presents some credible evidence, that the defendant consumed alcohol between the time that the defendant stopped driving and the time that testing occurred, such issue shall be an affirmative defense, and the prosecution must establish beyond a reasonable doubt that the minimum 0.08 blood or breath alcohol content required in this paragraph (a) was reached as a result of alcohol consumed by the defendant before the defendant stopped driving. DUI per se is a misdemeanor, but it is a class 4 felony if the violation occurred after three or more prior convictions, arising out of separate and distinct criminal episodes, for DUI, DUI per se, or DWAI; vehicular homicide, as described in section 18-3-106(1)(b), C.R.S .; vehicular assault, as described in section 18-3-205(1)(b), C.R.S .; or any combination thereof.

(a.5) Repealed by Laws 2015, Ch. 262, § 1, eff. Aug. 5, 2015.

(b) In any prosecution for the offense of DUI per se, the defendant shall be entitled to offer direct and circumstantial evidence to show that there is a disparity between what any tests show and other facts so that the trier of fact could infer that the tests were in some way defective or inaccurate. Such evidence may include testimony of non-expert witnesses relating to the absence of any or all of the common symptoms or signs of intoxication for the purpose of impeachment of the accuracy of the analysis of the person's blood or breath.

(c) Pursuant to section 16-2-106, C.R.S ., in charging the offense of DUI per se, it shall be sufficient to describe the offense charged as “drove a vehicle with excessive alcohol content”.

(d)

(I) It is a class A traffic infraction for any person under twenty-one years of age to drive a motor vehicle or vehicle when the person's BAC, as shown by analysis of the person's breath, is at least 0.02 but not more than 0.05 at the time of driving or within two hours after driving. The court, upon sentencing a defendant pursuant to this subparagraph (I), may order, in addition to any penalty imposed under a class A traffic infraction, that the defendant perform up to twenty-four hours of useful public service, subject to the conditions and restrictions of section 18-1.3-507, C.R.S., and may further order that the defendant submit to and complete an alcohol evaluation or assessment, an alcohol education program, or an alcohol treatment program at such defendant's own expense.

(II) A second or subsequent violation of this paragraph (d) is a class 2 traffic misdemeanor.

(3) The offenses described in subsections (1) and (2) of this section are strict liability offenses.

(4) No court shall accept a plea of guilty to a non-alcohol-related or non-drug-related traffic offense or guilty to the offense of UDD from a person charged with DUI or DUI per se; except that the court may accept a plea of guilty to a non-alcohol-related or non-drug-related traffic offense or to UDD upon a good faith representation by the prosecuting attorney that the attorney could not establish a prima facie case if the defendant were brought to trial on the original alcohol-related or drug-related offense.

(5) Notwithstanding the provisions of [section 18-1-408, C.R.S] ., during a trial of any person accused of both DUI and DUI per se, the court shall not require the prosecution to elect between the two violations. The court or a jury may consider and convict the person of either DUI or DWAI, or DUI per se, or both DUI and DUI per se, or both DWAI and DUI per se. If the person is convicted of more than one violation, the sentences imposed shall run concurrently.

(6)

(a) In any prosecution for DUI or DWAI, the defendant's BAC or drug content at the time of the commission of the alleged offense or within a reasonable time thereafter gives rise to the following presumptions or inferences:

(I) If at such time the defendant's BAC was 0.05 or less, it shall be presumed that the defendant was not under the influence of alcohol and that the defendant's ability to operate a motor vehicle or vehicle was not impaired by the consumption of alcohol.

(II) If at such time the defendant's BAC was in excess of 0.05 but less than 0.08, such fact gives rise to the permissible inference that the defendant's ability to operate a motor vehicle or vehicle was impaired by the consumption of alcohol, and such fact may also be considered with other competent evidence in determining whether or not the defendant was under the influence of alcohol.

(III) If at such time the defendant's BAC was 0.08 or more, such fact gives rise to the permissible inference that the defendant was under the influence of alcohol.

(IV) If at such time the driver's blood contained five nanograms or more of delta 9-tetrahydrocannabinol per milliliter in whole blood, as shown by analysis of the defendant's blood, such fact gives rise to a permissible inference that the defendant was under the influence of one or more drugs.

(b) The limitations of this subsection (6) shall not be construed as limiting the introduction, reception, or consideration of any other competent evidence bearing upon the question of whether or not the defendant was under the influence of alcohol or whether or not the defendant's ability to operate a motor vehicle or vehicle was impaired by the consumption of alcohol.

(c)

(I) In all actions, suits, and judicial proceedings in any court of this state concerning alcohol-related or drug-related traffic offenses, the court shall take judicial notice of methods of testing a person's alcohol or drug level and of the design and operation of devices, as certified by the department of public health and environment, for testing a person's blood, breath, saliva, or urine to determine such person's alcohol or drug level. The department of public health and environment may, by rule, determine that, because of the reliability of the results from certain devices, the collection or preservation of a second sample of a person's blood, saliva, or urine or the collection and preservation of a delayed breath alcohol specimen is not required.

(II) Nothing in this paragraph (c) prevents the necessity of establishing during a trial that the testing devices used were working properly and were properly operated. Nothing in this paragraph (c) precludes a defendant from offering evidence concerning the accuracy of testing devices.

(III) The database compiled by the department of public health and environment containing personal identifying information relating to the results of tests of persons' breath alcohol content, and all personal identifying information thereof, are not public information. The department of public health and environment shall disclose such information only to:

(A) The individual who is the subject of the test, or to his or her legal representative;

(B) A named interested party in a civil or criminal action in which the test results are directly related, or to his or her legal representative;

(C) Any prosecuting attorney, law enforcement officer, state agency, or state and local public official legally authorized to utilize such information to carry out his or her duties; or

(D) Any party who obtains an order in a pending civil or criminal case if the court finds the party has shown good cause to have the information. In determining whether there is good cause, the court shall consider whether the materials sought exist;

whether the materials sought are evidentiary and relevant; whether the materials are not otherwise procurable reasonably in advance of the proceeding by the exercise of due diligence; whether the party cannot properly prepare for the proceeding without such production and inspection in advance of the proceeding, and the failure to obtain such inspection may tend to unreasonably delay the proceeding; and whether the request for the information is made in good faith and is not for the purposes of general discovery.

(IV) The department of public health and environment may release nonpersonal identifying information from the database in accordance with sections 24-72-101 to 24-72-402, C.R.S .

(d) If a person refuses to take or to complete, or to cooperate with the completing of, any test or tests as provided in section 42-4-1301.1 and such person subsequently stands trial for DUI or DWAI, the refusal to take or to complete, or to cooperate with the completing of, any test or tests shall be admissible into evidence at the trial, and a person may not claim the privilege against self-incrimination with regard to admission of refusal to take or to complete, or to cooperate with the completing of, any test or tests.

(e) **Involuntary blood test--admissibility.** Evidence acquired through an involuntary blood test pursuant to section 42-4-1301.1(3) shall be admissible in any prosecution for DUI, DUI per se, DWAI, or UDD, and in any prosecution for criminally negligent homicide pursuant to section 18-3-105, C.R.S ., vehicular homicide pursuant to section 18-3-106(1)(b), C.R.S ., assault in the third degree pursuant to section 18-3-204, C.R.S ., or vehicular assault pursuant to section 18-3-205(1)(b), C.R.S .

(f) **Chemical test -- admissibility.** Strict compliance with the rules and regulations prescribed by the department of public health and environment shall not be a prerequisite to the admissibility of test results at trial unless the court finds that the extent of noncompliance with a board of health rule has so impaired the validity and reliability of the testing method and the test results as to render the evidence inadmissible. In all other circumstances, failure to strictly comply with such rules and regulations shall only be considered in the weight to be given to the test results and not to the admissibility of such test results.

(g) It shall not be a prerequisite to the admissibility of test results at trial that the prosecution present testimony concerning the composition of any kit used to obtain blood, urine, saliva, or breath specimens. A sufficient evidentiary foundation concerning the compliance of such kits with the rules and regulations of the department of public health and environment shall be established by the introduction of a copy of the manufacturer's or supplier's certificate of compliance with such rules and regulations if such certificate specifies the contents, sterility, chemical makeup, and amounts of chemicals contained in such kit.

(h) In any trial for a violation of this section, the testimony of a law enforcement officer that he or she witnessed the taking of a blood specimen by a person who the law enforcement officer reasonably believed was authorized to withdraw blood specimens shall be sufficient evidence that such person was so authorized, and testimony from the person who obtained the blood specimens concerning such person's authorization to obtain blood specimens shall not be a prerequisite to the admissibility of test results concerning the blood specimens obtained.

(i)

(I) Following the lawful contact with a person who has been driving a motor vehicle or vehicle and when a law enforcement officer reasonably suspects that a person was driving a motor vehicle or vehicle while under the influence of or while impaired by alcohol, the law enforcement officer may conduct a preliminary screening test using a device approved by the executive director of the department of public health and environment after first advising the driver that the driver may either refuse or agree to provide a sample of the driver's breath for such preliminary test; except that, if the driver is under twenty-one years of age, the law enforcement officer may, after providing such advisement to the person, conduct such preliminary screening test if the officer reasonably suspects that the person has consumed any alcohol.

(II) The results of this preliminary screening test may be used by a law enforcement officer in determining whether probable cause exists to believe such person was driving a motor vehicle or vehicle in violation of this section and whether to administer a test pursuant to section 42-4-1301.1(2) .

(III) Neither the results of such preliminary screening test nor the fact that the person refused such test shall be used in any court action except in a hearing outside of the presence of a jury, when such hearing is held to determine if a law enforcement officer had probable cause to believe that the driver committed a violation of this section. The results of such preliminary screening test shall be made available to the driver or the driver's attorney on request.

(j) In any trial for a violation of this section, if, at the time of the alleged offense, the person possessed a valid medical marijuana registry identification card, as defined in section 25-1.5-106(2)(e), C.R.S ., issued to himself or herself, the prosecution shall not use such fact as part of the prosecution's case in chief.

(k) In any traffic stop, the driver's possession of a valid medical marijuana registry identification card, as defined in section 25-1.5-106(2)(e), C.R.S ., issued to himself or herself shall not, in the absence of other contributing factors, constitute probable cause for a peace officer to require the driver to submit to an analysis of his or her blood.

(7) Repealed by Laws 2010, Ch. 258, § 1, eff. July 1, 2010.

(8) A second or subsequent violation of this section committed by a person under eighteen years of age may be filed in juvenile court.

§ 42-4-1301.1 Expressed consent for the taking of blood, breath, urine, or saliva sample--testing--fund--rules--repeal

(1) Any person who drives any motor vehicle upon the streets and highways and elsewhere throughout this state shall be deemed to have expressed such person's consent to the provisions of this section.

(2)

(a)

(I) A person who drives a motor vehicle upon the streets and highways and elsewhere throughout this state shall be required to take and complete, and to cooperate in the taking and completing of, any test or tests of the person's breath or blood for the purpose of determining the alcoholic content of the person's blood or breath when so requested and directed by a law enforcement officer having probable cause to believe that the person was driving a motor vehicle in violation of the prohibitions against DUI, DUI per se, DWAI, or UDD. Except as otherwise provided in this section, if a person who is twenty-one years of age or older requests that the test be a blood test, then the test shall be of his or her blood; but, if the person requests that a specimen of his or her blood not be drawn, then a specimen of the person's breath shall be obtained and tested. A person who is under twenty-one years of age shall be entitled to request a blood test unless the alleged violation is UDD, in which case a specimen of the person's breath shall be obtained and tested, except as provided in subparagraph (II) of this paragraph (a).

(II) Except as otherwise provided in paragraph (a.5) of this subsection (2), if a person elects either a blood test or a breath test, the person shall not be permitted to change the election, and, if the person fails to take and complete, and to cooperate in the completing of, the test elected, the failure shall be deemed to be a refusal to submit to testing. If the person is unable to take, or to complete, or to cooperate in the completing of a breath test because of injuries, illness, disease, physical infirmity, or physical incapacity, or if the person is receiving medical treatment at a location at which a breath testing instrument certified by the department of public health and environment is not available, the test shall be of the person's blood.

(III) If a law enforcement officer requests a test under this paragraph (a), the person must cooperate with the request such that the sample of blood or breath can be obtained within two hours of the person's driving.

(a.5)

(I) If a law enforcement officer who requests a person to take a breath or blood test under paragraph (a) of this subsection (2) determines there are extraordinary circumstances that prevent the completion of the test elected by the person within the two-hour time period required by subparagraph (III) of paragraph (a) of this subsection (2), the officer shall inform the person of the extraordinary circumstances and request and direct the person to take and complete the other test described in paragraph (a) of this subsection (2). The person shall then be required to take and complete, and to cooperate in the completing of, the other test.

(II) A person who initially requests and elects to take a blood or breath test, but who is requested and directed by the law enforcement officer to take the other test because of the extraordinary circumstances described in subparagraph (I) of this paragraph (a.5), may change his or her election for the purpose of complying with the officer's request. The change in the election of which test to take shall not be deemed to be a refusal to submit to testing.

(III) If the person fails to take and complete, and to cooperate in the completing of, the other test requested by the law enforcement officer pursuant to subparagraph (I) of this paragraph (a.5), the failure shall be deemed to be a refusal to submit to testing.

(IV)

(A) As used in this paragraph (a.5), “extraordinary circumstances” means circumstances beyond the control of, and not created by, the law enforcement officer who requests and directs a person to take a blood or breath test in accordance with this subsection (2) or the law enforcement authority with whom the officer is employed.

(B) “Extraordinary circumstances” includes, but shall not be limited to, weather-related delays, high call volume affecting medical personnel, power outages, malfunctioning breath test equipment, and other circumstances that preclude the timely collection and testing of a blood or breath sample by a qualified person in accordance with law.

(C) “Extraordinary circumstances” does not include inconvenience, a busy workload on the part of the law enforcement officer or law enforcement authority, minor delay that does not compromise the two-hour test period specified in subparagraph (III) of paragraph (a) of this subsection (2), or routine circumstances that are subject to the control of the law enforcement officer or law enforcement authority.

(b)

(I) Any person who drives any motor vehicle upon the streets and highways and elsewhere throughout this state shall be required to submit to and to complete, and to cooperate in the completing of, a test or tests of such person's blood, saliva, and urine for the purpose of determining the drug content within the person's system when so requested and directed by a law enforcement officer having probable cause to believe that the person was driving a motor vehicle in violation of the prohibitions against DUI or DWAI and when it is reasonable to require such testing of blood, saliva, and urine to determine whether such person was under the influence of, or impaired by, one or more drugs, or one or more controlled substances, or a combination of both alcohol and one or more drugs, or a combination of both alcohol and one or more controlled substances.

(II) If a law enforcement officer requests a test under this paragraph (b), the person must cooperate with the request such that the sample of blood, saliva, or urine can be obtained within two hours of the person's driving.

(3) Any person who is required to take and to complete, and to cooperate in the completing of, any test or tests shall cooperate with the person authorized to obtain specimens of such person's blood, breath, saliva, or urine, including the signing of any release or consent forms required by any person, hospital, clinic, or association authorized to obtain such specimens. If such person does not cooperate with the person, hospital, clinic, or association authorized to obtain such specimens, including the signing of any release or consent forms, such noncooperation shall be considered a refusal to submit to testing. No law enforcement officer shall physically restrain any person for the purpose of obtaining a specimen of such person's blood, breath, saliva, or urine for testing except when the officer has probable cause to believe that the person has committed criminally negligent homicide pursuant to section 18-3-105, C.R.S ., vehicular homicide pursuant to section 18-3-106(1)(b), C.R.S ., assault in the third degree pursuant to section 18-3-204, C.R.S ., or vehicular assault pursuant to section 18-3-205(1)(b), C.R.S ., and the person is refusing to take or to complete, or to cooperate in the completing of, any test or tests, then, in such event, the law enforcement officer may require a blood test.

(4) Any driver of a commercial motor vehicle requested to submit to a test as provided in paragraph (a) or (b) of subsection (2) of this section shall be warned by the law enforcement officer requesting the test that a refusal to submit to the test shall result in an out-of-service order as defined under section 42-2-402(8) for a period of

twenty-four hours and a revocation of the privilege to operate a commercial motor vehicle for one year as provided under section 42-2-126 .

(5) The tests shall be administered at the direction of a law enforcement officer having probable cause to believe that the person had been driving a motor vehicle in violation of section 42-4-1301 and in accordance with rules and regulations prescribed by the department of public health and environment concerning the health of the person being tested and the accuracy of such testing.

(6)

(a) No person except a physician, a registered nurse, a paramedic, as certified in part 2 of article 3.5 of title 25, C.R.S., an emergency medical service provider, as defined in part 1 of article 3.5 of title 25, C.R.S., or a person whose normal duties include withdrawing blood samples under the supervision of a physician or registered nurse shall withdraw blood to determine the alcoholic or drug content of the blood for purposes of this section.

(b) No civil liability shall attach to any person authorized to obtain blood, breath, saliva, or urine specimens or to any hospital, clinic, or association in or for which such specimens are obtained as provided in this section as a result of the act of obtaining such specimens from any person submitting thereto if such specimens were obtained according to the rules and regulations prescribed by the department of public health and environment; except that this provision shall not relieve any such person from liability for negligence in the obtaining of any specimen sample.

(7) A preliminary screening test conducted by a law enforcement officer pursuant to section 42-4-1301(6)(i) shall not substitute for or qualify as the test or tests required by subsection (2) of this section.

(8) Any person who is dead or unconscious shall be tested to determine the alcohol or drug content of the person's blood or any drug content within such person's system as provided in this section. If a test cannot be administered to a person who is unconscious, hospitalized, or undergoing medical treatment because the test would endanger the person's life or health, the law enforcement agency shall be allowed to test any blood, urine, or saliva that was obtained and not utilized by a health care provider and shall have access to that portion of the analysis and results of any tests administered by such provider that shows the alcohol or drug content of the person's blood, urine, or saliva or any drug content within the person's system. Such test results shall not be considered privileged communications, and the provisions of section 13-90-107, C.R.S ., relating to the physician-patient privilege shall not apply. Any person who is dead, in addition to the tests prescribed, shall also have the person's blood checked for carbon monoxide content and for the presence of drugs, as prescribed by the department of public health and environment. Such information obtained shall be made a part of the accident report.

(9)

(a) There is created in the state treasury the evidential breath-testing cash fund, referred to in this section as the “fund”, for the collection of moneys to purchase breath-testing devices for law enforcement agencies. The fund includes any moneys appropriated to the fund by the general assembly and any moneys credited to the fund pursuant to paragraph (c) of this subsection (9). The moneys in the fund are subject to annual appropriation by the general assembly to the department of public health and environment created in section 25-1-102, C.R.S ., for the purposes described in this subsection (9).

(b) All interest derived from the deposit and investment of moneys in the fund must remain in the fund. Any unexpended or unencumbered moneys remaining in the fund at the end of a fiscal year must remain in the fund and not be transferred or credited to the general fund or another fund; except that any such unexpended and unencumbered moneys in excess of two million dollars must be credited to the general fund.

(c) The department of public health and environment is authorized to accept any gifts, grants, or donations from any private or public source on behalf of the state for the purposes described in this section. The department of public health and environment shall transmit all such gifts, grants, and donations to the state treasurer, who shall credit the same to the fund.

(d) The state board of health created in section 25-1-103, C.R.S ., may promulgate rules for the administration of the fund for the purposes described in this subsection (9).

(e) This subsection (9) is repealed, effective September 1, 2024. Before repeal, the department of regulatory agencies, pursuant to 24-34-104, shall review the use of the fund by the department of public health and environment for the purposes described in this subsection (9).

§ 42-4-1301.3 Alcohol and drug driving safety program

(1)

(a) Upon conviction of a violation of section 42-4-1301 , the court shall sentence the defendant in accordance with the provisions of this section and other applicable provisions of this part 13. The court shall consider the alcohol and drug evaluation required pursuant to this section prior to sentencing; except that the court may proceed to immediate sentencing without considering such alcohol and drug evaluation:

(I)

(A) If the defendant has no prior convictions or pending charges under this section; or

(B) If the defendant has one or more prior convictions, the prosecuting attorney and the defendant have stipulated to such conviction or convictions; and

(II) If neither the defendant nor the prosecuting attorney objects.

(b) If the court proceeds to immediate sentencing, without considering an alcohol and drug evaluation, the alcohol and drug evaluation shall be conducted after sentencing, and the court shall order the defendant to complete the education and treatment program recommended in the alcohol and drug evaluation. If the defendant disagrees with the education and treatment program recommended in the alcohol and drug evaluation, the defendant may request the court to hold a hearing to determine which education and treatment program should be completed by the defendant.

(2) Deleted by Laws 2011, Ch. 267, § 1, eff. June 2, 2011.

(3)

(a) The judicial department shall administer in each judicial district an alcohol and drug driving safety program that provides presentence and postsentence alcohol and drug evaluations on all persons convicted of a violation of section 42-4-1301 . The alcohol and drug driving safety program shall further provide supervision and monitoring of all such persons whose sentences or terms of probation require completion of a program of alcohol and drug driving safety education or treatment.

(b) The presentence and postsentence alcohol and drug evaluations shall be conducted by such persons determined by the judicial department to be qualified to provide evaluation and supervision services as described in this section.

(c)

(I) An alcohol and drug evaluation shall be conducted on all persons convicted of a violation of section 42-4-1301 , and a copy of the report of the evaluation shall be provided to such person. The report shall be made available to and shall be considered by the court prior to sentencing unless the court proceeds to immediate sentencing pursuant to the provisions of subsection (1) of this section.

(II) The report shall contain the defendant's prior traffic record, characteristics and history of alcohol or drug problems, and amenability to rehabilitation. The report shall include a recommendation as to alcohol and drug driving safety education or treatment for the defendant.

(III) The alcohol evaluation shall be conducted and the report prepared by a person who is trained and knowledgeable in the diagnosis of chemical dependency. Such person's duties may also include appearing at sentencing and probation hearings as required, referring defendants to education and treatment agencies in accordance with orders of the court, monitoring defendants in education and treatment programs, notifying the probation department and the court of any defendant failing to meet the conditions of probation or referral to education or treatment, appearing at revocation hearings as required, and providing assistance in data reporting and program evaluation.

(IV) For the purpose of this section, “alcohol and drug driving safety education or treatment” means either level I or level II education or treatment programs that are approved by the unit in the department of human services that administers behavioral health programs and services, including those related to mental health and substance abuse. Level I programs are to be short-term, didactic education programs. Level II programs are to be therapeutically oriented education, long-term outpatient, and comprehensive residential programs. Any defendant sentenced to level I or level II programs shall be instructed by the court to meet all financial obligations of such programs. If such financial obligations are not met, the sentencing court shall be notified for the purpose of collection or review and further action on the defendant's sentence. Nothing in this section shall prohibit treatment agencies from applying to the state for funds to recover the costs of level II treatment for defendants determined to be indigent by the court.

(4)

(a) There is hereby created an alcohol and drug driving safety program fund in the office of the state treasurer to the credit of which shall be deposited all moneys as directed by this paragraph (a). The assessment in effect on July 1, 1998, shall remain in effect unless the judicial department and the unit in the department of human services that administers behavioral health programs and services, including those related to mental health and substance abuse, have provided to the general assembly a statement of the cost of the program, including costs of administration for the past and current fiscal year to include a proposed change in the assessment. The general assembly shall then consider the proposed new assessment and approve the amount to be assessed against each person during the following fiscal year in order to ensure that the alcohol and drug driving safety program established in this section shall be financially self-supporting. Any adjustment in the amount to be assessed shall be so noted in the appropriation to the judicial department and the unit in the department of human services that administers behavioral health programs and services, including those related to mental health and substance abuse, as a footnote or line item related to this program in the general appropriation bill. The state auditor shall periodically audit the costs of the programs to determine that they are reasonable and that the rate charged is accurate based on these costs. Any other fines, fees, or costs levied against such person shall not be part of the program fund. The amount assessed for the alcohol and drug evaluation shall be transmitted by the court to the state treasurer to be credited to the alcohol and drug driving safety program fund. Fees charged under sections 27-81-106(1)and 27-82-103(1), C.R.S ., to approved alcohol and drug treatment facilities that provide level I and level II programs as provided in paragraph (c) of subsection (3) of this section shall be transmitted to the state treasurer, who shall credit the fees to the alcohol and drug driving safety program fund. Upon appropriation by the general assembly, these funds shall be expended by the judicial department and the unit in the department of human services that administers behavioral health programs and services, including those related to mental health and substance abuse, for the administration of the alcohol and drug driving safety program. In administering the alcohol and drug driving safety program, the judicial department is authorized to contract with any agency for such services as the judicial department deems necessary. Moneys deposited in the alcohol and drug driving safety program fund shall remain in said fund to be used for the purposes set forth in this section and shall not revert or transfer to the general fund except by further act of the general assembly.

(b) The judicial department shall ensure that qualified personnel are placed in the judicial districts. The judicial department and the unit in the department of human services that administers behavioral health programs and services, including those related to mental health and substance abuse, shall jointly develop and maintain criteria for evaluation techniques, treatment referral, data reporting, and program evaluation.

(c) The alcohol and drug driving safety program shall cooperate in providing services to a defendant who resides in a judicial district other than the one in which the arrest was made. Alcohol and drug driving safety programs may cooperate in providing services to any defendant who resides at a location closer to another judicial district's program. The requirements of this section shall not apply to persons who are not residents of Colorado at the time of sentencing.

(d) Notwithstanding any provision of paragraph (a) of this subsection (4) to the contrary, on March 5, 2003, the state treasurer shall deduct one million dollars from the alcohol and drug driving safety program fund and transfer such sum to the general fund.

(5) The provisions of this section are also applicable to any defendant who receives a diversion in accordance with section 18-1.3-101, C.R.S ., or who receives a deferred sentence in accordance with section 18-1.3-102, C.R.S ., and the completion of any stipulated alcohol evaluation, level I or level II education program, or level I or level II treatment program to be completed by the defendant shall be ordered by the court in accordance with the

conditions of such deferred prosecution or deferred sentence as stipulated to by the prosecution and the defendant.

(6) An approved alcohol or drug treatment facility that provides level I or level II programs as provided in paragraph (c) of subsection (3) of this section shall not require a person to repeat any portion of an alcohol and drug driving safety education or treatment program that he or she has successfully completed while he or she was imprisoned for the current offense.

§ 42-4-1302 Stopping of suspect

A law enforcement officer may stop any person who the officer reasonably suspects is committing or has committed a violation of section 42-4-1301(1) or (2) and may require the person to give such person's name, address, and an explanation of his or her actions. The stopping shall not constitute an arrest.

§ 42-4-1303 Records--*prima facie* proof

Official records of the department of public health and environment relating to certification of breath test instruments, certification of operators and operator instructors of breath test instruments, certification of standard solutions, and certification of laboratories shall be official records of the state, and copies thereof, attested by the executive director of the department of public health and environment or the director's deputy and accompanied by a certificate bearing the official seal for said department that the executive director or the director's deputy has custody of said records, shall be admissible in all courts of record and shall constitute prima facie proof of the information contained therein. The department seal required under this section may also consist of a rubber stamp producing a facsimile of the seal stamped upon the document.

§ 42-4-1304 Samples of blood or other bodily substance--duties of department of public health and environment

(1) The department of public health and environment shall establish a system for obtaining samples of blood or other bodily substance from the bodies of all pilots in command, vessel operators in command, or drivers and pedestrians fifteen years of age or older who die within four hours after involvement in a crash involving a motor vehicle, a vessel, or an aircraft. For purposes of this section, “vessel” has the meaning set forth in section 33-13-102, C.R.S . No person having custody of the body of the deceased shall perform any internal embalming procedure until a blood and urine specimen to be tested for alcohol, drug, and carbon monoxide concentrations has been taken by an appropriately trained person certified by the department of public health and environment. Whenever the driver of the vehicle cannot be immediately determined, the samples shall be obtained from all deceased occupants of the vehicle.

(2) All samples so collected shall be placed in containers of a type designed to preserve the integrity of a sample from the time of collection until it is subjected to analysis.

(3) All samples shall be tested and analyzed in the laboratories of the department of public health and environment, or in any other laboratory approved for this purpose by the department of public health and environment, to determine the amount of alcohol, drugs, and carbon monoxide contained in such samples or the amount of any other substance contained therein as deemed advisable by the department of public health and environment.

(4) The state board of health shall establish and promulgate such administrative regulations and procedures as are necessary to ensure that collection and testing of samples is accomplished to the fullest extent. Such regulations and procedures shall include but not be limited to the following:

(a) The certification of laboratories to ensure that the collection and testing of samples is performed in a competent manner, which may include waiving specific certification requirements for laboratories that are accredited by the American board of forensic toxicology, the international standards organization, or a successor to either organization; and

(b) The designation of responsible state and local officials who shall have authority and responsibility to collect samples for testing.

(5) All records of the results of such tests shall be compiled by the department of public health and environment and shall not be public information, but shall be disclosed on request to any interested party in any civil or criminal action arising out of the collision.
(6) All state and local public officials, including investigating law enforcement officers, have authority to and shall follow the procedures established by the department of public health and environment pursuant to this section, including the release of all information to the department of public health and environment concerning such samples and the testing thereof. The Colorado state patrol and the county coroners and their deputies shall assist the department of public health and environment in the administration and collection of such samples for the purposes of this section.
(7) The office of the highway safety coordinator, the department, and the Colorado state patrol shall have access to the results of the tests of such samples taken as a result of a traffic crash for statistical analysis. The division of parks and wildlife shall have access to the results of the tests of such samples taken as a result of a boating accident for statistical analysis.
(8) Failure to perform the required duties as prescribed by this section and by the administrative regulations and procedures resulting therefrom shall be deemed punishable under section 18-8-405, C.R.S .

§ 42-4-1305 Open alcoholic beverage container--motor vehicle--prohibited

(1) Definitions. As used in this section, unless the context otherwise requires:

(a) "Alcoholic beverage" means a beverage as defined in 23 CFR 1270.3(a) .

(b) "Motor vehicle" means a vehicle driven or drawn by mechanical power and manufactured primarily for use on public highways but does not include a vehicle operated exclusively on a rail or rails.

(c) "Open alcoholic beverage container" means a bottle, can, or other receptacle that contains any amount of alcoholic beverage and:

(I) That is open or has a broken seal; or

(II) The contents of which are partially removed.

(d) "Passenger area" means the area designed to seat the driver and passengers while a motor vehicle is in operation and any area that is readily accessible to the driver or a passenger while in his or her seating position, including but not limited to the glove compartment.

(2)

(a) Except as otherwise permitted in paragraph (b) of this subsection (2), a person while in the passenger area of a motor vehicle that is on a public highway of this state or the right-of-way of a public highway of this state may not knowingly:

(I) Drink an alcoholic beverage; or

(II) Have in his or her possession an open alcoholic beverage container.

(b) The provisions of this subsection (2) shall not apply to:

(I) Passengers, other than the driver or a front seat passenger, located in the passenger area of a motor vehicle designed, maintained, or used primarily for the transportation of persons for compensation;

(II) The possession by a passenger, other than the driver or a front seat passenger, of an open alcoholic beverage container in the living quarters of a house coach, house trailer, motor home, as defined in section 42-1-102(57) , or trailer coach, as defined in section 42-1-102(106)(a) ;

(III) The possession of an open alcoholic beverage container in the area behind the last upright seat of a motor vehicle that is not equipped with a trunk; or

(IV) The possession of an open alcoholic beverage container in an area not normally occupied by the driver or a passenger in a motor vehicle that is not equipped with a trunk.

(c) A person who violates the provisions of this subsection (2) commits a class A traffic infraction and shall be punished by a fine of fifty dollars and a surcharge of sixteen dollars as provided in section 42-4-1701(4)(a)(I)(N) .

§ 42-4-1305.5 Open marijuana container--motor vehicle--prohibited

(1) **Definitions.** As used in this section, unless the context otherwise requires:

(a) “Marijuana” shall have the same meaning as in section 16(2)(f) of article XVIII of the state constitution .

(b) “Motor vehicle” means a vehicle driven or drawn by mechanical power and manufactured primarily for use on public highways but does not include a vehicle operated exclusively on a rail or rails.

(c) “Open marijuana container” means a receptacle or marijuana accessory that contains any amount of marijuana and:

(I) That is open or has a broken seal;

(II) The contents of which are partially removed; and

(III) There is evidence that marijuana has been consumed within the motor vehicle.

(d) “Passenger area” means the area designed to seat the driver and passengers, including seating behind the driver, while a motor vehicle is in operation and any area that is readily accessible to the driver or a passenger while in his or her seating position, including but not limited to the glove compartment.

(2)

(a) Except as otherwise permitted in paragraph (b) of this subsection (2), a person while in the passenger area of a motor vehicle that is on a public highway of this state or the right-of-way of a public highway of this state may not knowingly:

(I) Use or consume marijuana; or

(II) Have in his or her possession an open marijuana container.

(b) The provisions of this subsection (2) shall not apply to:

(I) Passengers, other than the driver or a front seat passenger, located in the passenger area of a motor vehicle designed, maintained, or used primarily for the transportation of persons for compensation;

(II) The possession by a passenger, other than the driver or a front seat passenger, of an open marijuana container in the living quarters of a house coach, house trailer, motor home, as defined in section 42-1-102(57) , or trailer coach, as defined in section 42-1-102(106)(a) ;

(III) The possession of an open marijuana container in the area behind the last upright seat of a motor vehicle that is not equipped with a trunk; or

(IV) The possession of an open marijuana container in an area not normally occupied by the driver or a passenger in a motor vehicle that is not equipped with a trunk.

(c) A person who violates the provisions of this subsection (2) commits a class A traffic infraction and shall be punished by a fine of fifty dollars and a surcharge of seven dollars and eighty cents as provided in this section and section 42-4-1701(4)(a)(I)(N) .

(3) Nothing in this section shall be construed to preempt or limit the authority of any statutory or home rule town, city, or city and county to adopt ordinances that are no less restrictive than the provisions of this section.

§ 42-4-1307 Penalties for traffic offenses involving alcohol and drugs--legislative declaration--definitions--repeal

(1) Legislative declaration. The general assembly hereby finds and declares that, for the purposes of sentencing as described in section 18-1-102.5, C.R.S ., each sentence for a conviction of a violation of section 42-4-1301 shall include:

(a) A period of imprisonment, which, for a repeat offender, shall include a mandatory minimum period of imprisonment and restrictions on where and how the sentence may be served; and

(b) For a second or subsequent offender, a period of probation. The imposition of a period of probation upon the conviction of a first-time offender shall be subject to the court's discretion as described in paragraph (c) of subsection (3) and paragraph (c) of subsection (4) of this section. The purpose of probation is to help the offender change his or her behavior to reduce the risk of future violations of section 42-4-1301. If a court imposes imprisonment as a penalty for a violation of a condition of his or her probation, the penalty shall constitute a separate period of imprisonment that the offender shall serve in addition to the imprisonment component of his or her original sentence.

(2) Definitions. As used in this section, unless the context otherwise requires:

(a) “Approved ignition interlock device” has the same meaning as set forth in section 42-2-132.5 .

(b) “Conviction” means a verdict of guilty by a judge or jury or a plea of guilty or nolo contendere that is accepted by the court for an offense or adjudication for an offense that would constitute a criminal offense if committed by an adult. “Conviction” also includes having received a deferred judgment and sentence or deferred adjudication; except that a person shall not be deemed to have been convicted if the person has successfully completed a deferred sentence or deferred adjudication.

(c) “Driving under the influence” or “DUI” means driving a motor vehicle or vehicle when a person has consumed alcohol or one or more drugs, or a combination of alcohol and one or more drugs, that affects the person to a degree that the person is substantially incapable, either mentally or physically, or both mentally and physically, of exercising clear judgment, sufficient physical control, or due care in the safe operation of a vehicle.

(d) “Driving while ability impaired” or “DWAI” means driving a motor vehicle or vehicle when a person has consumed alcohol or one or more drugs, or a combination of both alcohol and one or more drugs, that affects the person to the slightest degree so that the person is less able than the person ordinarily would have been, either mentally or physically, or both mentally and physically, to exercise clear judgment, sufficient physical control, or due care in the safe operation of a vehicle.

(e) “UDD” shall have the same meaning as provided in section 42-1-102(109.7) .

(3) First offenses--DUI and DUI per se.

(a) Except as otherwise provided in subsections (5) and (6) of this section, a person who is convicted of DUI or DUI per se shall be punished by:

(I) Imprisonment in the county jail for at least five days but no more than one year, the minimum period of which shall be mandatory; except that the court may suspend the mandatory minimum period if, as a condition of the suspended sentence, the offender undergoes a presentence or post sentence alcohol and drug evaluation and satisfactorily completes and meets all financial obligations of a level I or level II program as is determined to be appropriate by the alcohol and drug evaluation that is required pursuant to section 42-4-1301.3 ;

(II) A fine of at least six hundred dollars but no more than one thousand dollars, and the court shall have discretion to suspend the fine; and

(III) At least forty-eight hours but no more than ninety-six hours of useful public service, and the court shall not have discretion to suspend the mandatory minimum period of performance of such service.

(b) Notwithstanding the provisions of subparagraph (I) of paragraph (a) of this subsection (3), and except as described in paragraphs (a) and (b) of subsection (5) and paragraph (a) of subsection (6) of this section, a person who is convicted of DUI or DUI per se when the person's BAC was 0.20 or more at the time of driving or within two hours after driving shall be punished by imprisonment in the county jail for at least ten days but not more than one year; except that the court shall have the discretion to employ the sentencing alternatives described in section 18-1.3-106, C.R.S .

(c) In addition to any penalty described in paragraph (a) of this subsection (3), the court may impose a period of probation that shall not exceed two years, which probation may include any conditions permitted by law.

(4) First offenses--DWAI.

(a) Except as otherwise provided in subsections (5) and (6) of this section, a person who is convicted of DWAI shall be punished by:

(I) Imprisonment in the county jail for at least two days but no more than one hundred eighty days, the minimum period of which shall be mandatory; except that the court may suspend the mandatory minimum period if, as a condition of the suspended sentence, the offender undergoes a presentence or post sentence alcohol and drug evaluation and satisfactorily completes and meets all financial obligations of a level I or level II program as is determined to be appropriate by the alcohol and drug evaluation that is required pursuant to section 42-4-1301.3 ; and

(II) A fine of at least two hundred dollars but no more than five hundred dollars, and the court shall have discretion to suspend the fine; and

(III) At least twenty-four hours but no more than forty-eight hours of useful public service, and the court shall not have discretion to suspend the mandatory minimum period of performance of such service.

(b) Notwithstanding the provisions of subparagraph (I) of paragraph (a) of this subsection (4), and except as described in paragraphs (a) and (b) of subsection (5) and paragraph (a) of subsection (6) of this section, a person who is convicted of DWAI when the person's BAC was 0.20 or more at the time of driving or within two hours after driving shall be punished by imprisonment in the county jail for at least ten days but not more than one year; except that the court shall have the discretion to employ the sentencing alternatives described in section 18-1.3-106, C.R.S .

(c) In addition to any penalty described in paragraph (a) of this subsection (4), the court may impose a period of probation that shall not exceed two years, which probation may include any conditions permitted by law.

(5) Second offenses.

(a) Except as otherwise provided in subsection (6) of this section, a person who is convicted of DUI, DUI per se, or DWAI who, at the time of sentencing, has a prior conviction of DUI, DUI per se, DWAI, vehicular homicide pursuant to section 18-3-106(1)(b), C.R.S ., vehicular assault pursuant to section 18-3-205(1)(b), C.R.S ., aggravated driving with a revoked license pursuant to section 42-2-206(1)(b)(I)(A) or (1)(b)(I)(B) , as that crime existed before August 5, 2015, or driving while the person's driver's license was under restraint pursuant to section 42-2-138(1)(d) , shall be punished by:

(I) Imprisonment in the county jail for at least ten consecutive days but no more than one year; except that the court shall have discretion to employ the sentencing alternatives described in section 18-1.3-106, C.R.S . During the mandatory ten-day period of imprisonment, the person shall not be eligible for earned time or good time pursuant to section 17-26-109, C.R.S ., or for trusty prisoner status pursuant to section 17-26-115, C.R.S .; except that the person shall receive credit for any time that he or she served in custody for the violation prior to his or her conviction.

(II) A fine of at least six hundred dollars but no more than one thousand five hundred dollars, and the court shall have discretion to suspend the fine;

(III) At least forty-eight hours but no more than one hundred twenty hours of useful public service, and the court shall not have discretion to suspend the mandatory minimum period of performance of the service; and

(IV) A period of probation of at least two years, which period shall begin immediately upon the commencement of any part of the sentence that is imposed upon the person pursuant to this section, and a suspended sentence of imprisonment in the county jail for one year, as described in subsection (7) of this section; except that the court shall not sentence the defendant to probation if the defendant is sentenced to the department of corrections but shall still sentence the defendant to the provisions of paragraph (b)of subsection (7) of this section. The defendant shall complete all court-ordered programs pursuant to paragraph (b) of subsection (7) of this section before the completion of his or her period of parole.

(b) If a person is convicted of DUI, DUI per se, or DWAI and the violation occurred less than five years after the date of a previous violation for which the person was convicted of DUI, DUI per se, DWAI, vehicular homicide pursuant to section 18-3-106(1)(b), C.R.S ., vehicular assault pursuant to section 18-3-205(1)(b), C.R.S ., aggravated driving with a revoked license pursuant to section 42-2-206(1)(b)(I)(A)or (1)(b)(I)(B) , as that crime existed before August 5, 2015, or driving while the person's driver's license was under restraint pursuant to section 42-2-138(1)(d) , the court does not have discretion to employ any sentencing alternatives described in section 18-1.3-106, C.R.S ., during the minimum period of imprisonment described in subparagraph (I) of paragraph (a) of this subsection (5); except that a court may allow the person to participate in a program pursuant to section 18-1.3-106(1)(a)(II) , (1)(a)(IV) , or (1)(a)(V), C.R.S ., only if the program is available through the county in which the person is imprisoned and only for the purpose of:

(I) Continuing a position of employment that the person held at the time of sentencing for said violation;

(II) Continuing attendance at an educational institution at which the person was enrolled at the time of sentencing for said violation; or

(III) Participating in a court-ordered level II alcohol and drug driving safety education or treatment program, as described in section 42-4-1301.3(3)(c)(IV) .

(c) Notwithstanding the provisions of section 18-1.3-106(12), C.R.S ., if, pursuant to paragraph (a) or (b) of this subsection (5), a court allows a person to participate in a program pursuant to section 18-1.3-106, C.R.S ., the person shall not receive one day credit against his or her sentence for each day spent in such a program, as provided in said section 18-1.3-106(12), C.R.S .

(6) Third and subsequent offenses.

(a) Except as provided in section 42-4-1301(1)(a) , (1)(b) , and (2)(a) , a person who is convicted of DUI, DUI per se, or DWAI who, at the time of sentencing, has two or more prior convictions of DUI, DUI per se, DWAI, vehicular homicide pursuant to section 18-3-106(1)(b), C.R.S ., vehicular assault pursuant to section 18-3-205(1)(b), C.R.S ., aggravated driving with a revoked license pursuant to section 42-2-206(1)(b)(I)(A) or (1)(b)(I)(B) , as that crime existed before August 5, 2015, or driving while the person's driver's license was under restraint pursuant to section 42-2-138(1)(d) shall be punished by:

(I) Imprisonment in the county jail for at least sixty consecutive days but no more than one year. During the mandatory sixty-day period of imprisonment, the person shall not be eligible for earned time or good time pursuant to section 17-26-109, C.R.S ., or for trusty prisoner status pursuant to section 17-26-115, C.R.S .; except that a person shall receive credit for any time that he or she served in custody for the violation prior to his or her conviction. During the mandatory period of imprisonment, the court shall not have any discretion to employ any sentencing alternatives described in section 18-1.3-106, C.R.S .; except that the person may participate in a program pursuant to section 18-1.3-106(1)(a)(II) , (1)(a)(IV) , or (1)(a)(V), C.R.S ., only if the program is available through the county in which the person is imprisoned and only for the purpose of:

(A) Continuing a position of employment that the person held at the time of sentencing for said violation;

(B) Continuing attendance at an educational institution at which the person was enrolled at the time of sentencing for said violation; or

(C) Participating in a court-ordered level II alcohol and drug driving safety education or treatment program, as described in section 42-4-1301.3(3)(c)(IV) ;

(II) A fine of at least six hundred dollars but no more than one thousand five hundred dollars, and the court shall have discretion to suspend the fine;

(III) At least forty-eight hours but no more than one hundred twenty hours of useful public service, and the court shall not have discretion to suspend the mandatory minimum period of performance of the service; and

(IV) A period of probation of at least two years, which period shall begin immediately upon the commencement of any part of the sentence that is imposed upon the person pursuant to this section, and a suspended sentence of imprisonment in the county jail for one year, as described in subsection (7) of this section; except that the court shall not sentence the defendant to probation if the defendant is sentenced to the department of corrections, but shall still sentence the defendant to the provisions of paragraph (b) of subsection (7) of this section. The defendant shall complete all court-ordered programs pursuant to paragraph (b) of subsection (7) of this section before the completion of his or her period of parole.

(b) Notwithstanding the provisions of section 18-1.3-106(12), C.R.S ., if, pursuant to paragraph (a) of this subsection (6), a court allows a person to participate in a program pursuant to section 18-1.3-106(1)(a)(II) , (1)(a)(IV) , or (1)(a)(V), C.R.S ., the person shall not receive one day credit against his or her sentence for each day spent in such a program, as provided in said section 18-1.3-106(12), C.R.S .

(c) Notwithstanding any other provision of law, if the defendant satisfies the conditions described in subparagraphs (I) and (II) of this paragraph (c), the court may include as a condition of probation a requirement that the defendant participate in alcohol treatment. If the defendant's assessed treatment need is for residential treatment, the court may make residential alcohol treatment a condition of probation and may place the offender in a community corrections program that can provide the appropriate level of treatment. This paragraph (c) applies only if:

(I) At the time of sentencing, the person has two prior convictions of DUI, DUI per se, DWAI, vehicular homicide pursuant to section 18-3-106(1)(b), C.R.S ., or vehicular assault pursuant to section 18-3-205(1)(b), C.R.S .; and

(II) The first of the person's two prior convictions was based on a violation that occurred not more than seven years before the violation for which the person is being sentenced.

(7) Probation-related penalties. When a person is sentenced to a period of probation pursuant to subparagraph (IV) of paragraph (a) of subsection (5) of this section or subparagraph (IV) of paragraph (a) of subsection (6) of this section:

(a) The court shall impose a sentence to one year of imprisonment in the county jail, which sentence shall be suspended, and against which sentence the person shall not receive credit for any period of imprisonment to which he or she is sentenced pursuant to subparagraph (I) of paragraph (a) of subsection (5) of this section or subparagraph (I) of paragraph (a) of subsection (6) of this section;

(b) The court:

(I) Shall include, as a condition of the person's probation, a requirement that the person complete a level II alcohol and drug driving safety education or treatment program, as described in section 42-4-1301.3(3)(c)(IV) , at the person's own expense;

(II) May impose an additional period of probation for the purpose of monitoring the person or ensuring that the person continues to receive court-ordered alcohol or substance abuse treatment, which additional period shall not exceed two years;

(III) May require that the person commence the alcohol and drug driving safety education or treatment program described in subparagraph (I) of this paragraph (b) during any period of imprisonment to which the person is sentenced;

(IV) May require the person to appear before the court at any time during the person's period of probation;

(V) May require the person to use an approved ignition interlock device during the period of probation at the person's own expense;

(VI) May require the person to submit to continuous alcohol monitoring using such technology or devices as are available to the court for such purpose; and

(VII) May impose such additional conditions of probation as may be permitted by law.

(c)

(I) The court may impose all or part of the suspended sentence described in subparagraph (IV) of paragraph (a) of subsection (5) of this section or subparagraph (IV) of paragraph (a) of subsection (6) of this section at any time during the period of probation if the person violates a condition of his or her probation. During the period of imprisonment, the person shall continue serving the probation sentence with no reduction in time for the sentence to probation. A cumulative period of imprisonment imposed pursuant to this paragraph (c) shall not exceed one year. In imposing a sentence of imprisonment pursuant to paragraph (a) of this subsection (7), the court shall consider the nature of the violation, the report or testimony of the probation department, the impact on public safety, the progress of the person in any court-ordered alcohol and drug driving safety education or treatment program, and any other information that may assist the court in promoting the person's compliance with the conditions of his or her probation.

(II) Any imprisonment imposed upon a person by the court pursuant to paragraph (a) of this subsection (7) must be imposed in a manner that promotes the person's compliance with the conditions of his or her probation and not merely as a punitive measure.

(d) The prosecution, the person, the person's counsel, or the person's probation officer may petition the court at any time for an early termination of the period of probation, which the court may grant upon a finding of the court that:

(I) The person has successfully completed a level II alcohol and drug driving safety education or treatment program pursuant to subparagraph (I) of paragraph (b) of this subsection (7);

(II) The person has otherwise complied with the terms and conditions of his or her probation; and

(III) Early termination of the period of probation will not endanger public safety.

(8) Ignition interlock devices. In sentencing a person pursuant to this section, courts are encouraged to require the person to use an approved ignition interlock device as a condition of bond, probation, and participation in programs pursuant to section 18-1.3-106, C.R.S .

(9) Previous convictions.

(a) For the purposes of subsections (5) and (6) of this section, a person is deemed to have a previous conviction for DUI, DUI per se, DWAI, vehicular homicide pursuant to section 18-3-106(1)(b), C.R.S ., vehicular assault pursuant to section 18-3-205(1)(b), C.R.S ., aggravated driving with a revoked license pursuant to section 42-2-206(1)(b)(I)(A) or (1)(b)(I)(B) , as that crime existed before August 5, 2015, or driving while the person's driver's license was under restraint pursuant to section 42-2-138(1)(d) , if the person has been convicted under the laws of this state or under the laws of any other state, the United States, or any territory subject to the jurisdiction of the United States, of an act that, if committed within this state, would constitute the offense of DUI, DUI per se, DWAI, vehicular homicide pursuant to section 18-3-106(1)(b), C.R.S ., vehicular assault pursuant to section 18-3-205(1)(b), C.R.S ., aggravated driving with a revoked license pursuant to section 42-2-206(1)(b)(I)(A) or (1)(b)(I)(B) , as that crime existed before August 5, 2015, or driving while the person's driver's license was under restraint pursuant to section 42-2-138(1)(d) .

(b)

(I) For sentencing purposes concerning convictions for second and subsequent offenses, prima facie proof of a person's previous convictions shall be established when:

(A) The prosecuting attorney and the person stipulate to the existence of the prior conviction or convictions;

(B) The prosecuting attorney presents to the court a copy of the person's driving record provided by the department of revenue or by a similar agency in another state, which record contains a reference to the previous conviction or convictions; or

(C) The prosecuting attorney presents an authenticated copy of the record of the previous conviction or judgment from a court of record of this state or from a court of any other state, the United States, or any territory subject to the jurisdiction of the United States.

(II) The court shall not proceed to immediate sentencing if the prosecuting attorney and the person have not stipulated to previous convictions or if the prosecution has requested an opportunity to obtain a driving record or a copy of a court record. The prosecuting attorney shall not be required to plead or prove any previous convictions at trial.

(10) Additional costs and surcharges. In addition to the penalties prescribed in this section:

(a) Persons convicted of DUI, DUI per se, DWAI, and UDD are subject to the costs imposed by section 24-4.1-119(1)(c), C.R.S ., relating to the crime victim compensation fund;

(b) Persons convicted of DUI, DUI per se, and DWAI are subject to a surcharge of at least one hundred dollars but no more than five hundred dollars to fund programs to reduce the number of persistent drunk drivers. The surcharge shall be mandatory, and the court shall not have discretion to suspend or waive the surcharge; except that the court may suspend or waive the surcharge if the court determines that a person is indigent. Moneys collected for the surcharge shall be transmitted to the state treasurer, who shall credit the amount collected to the persistent drunk driver cash fund created in section 42-3-303 .

(c) Persons convicted of DUI, DUI per se, DWAI, and UDD are subject to a surcharge of twenty dollars to be transmitted to the state treasurer who shall deposit moneys collected for the surcharge in the Colorado traumatic brain injury trust fund created pursuant to section 26-1-309, C.R.S .;

(d)

(I) Persons convicted of DUI, DUI per se, and DWAI are subject to a surcharge of at least one dollar but no more than ten dollars for programs to fund efforts to address alcohol and substance abuse problems among persons in rural areas. The surcharge shall be mandatory, and the court shall not have discretion to suspend or waive the surcharge; except that the court may suspend or waive the surcharge if the court determines that a person is indigent. Any moneys collected for the surcharge shall be transmitted to the state treasurer, who shall credit the same to the rural alcohol and substance abuse cash fund created in section 27-80-117(3), C.R.S .

(II) This paragraph (d) is repealed, effective July 1, 2016, unless the general assembly extends the repeal 1 of the rural alcohol and substance abuse prevention and treatment program created in section 27-80-117, C.R.S .

(11) Restitution. As a condition of any sentence imposed pursuant to this section, the sentenced person shall be required to make restitution in accordance with the provisions of section 18-1.3-205, C.R.S .

(12) Victim impact panels.

(a) In addition to any other penalty provided by law, the court may sentence a person convicted of DUI, DUI per se, DWAI, or UDD to attend in person and pay for one appearance at a victim impact panel approved by the court, for which the fee assessed to the person shall not exceed fifty dollars.

(b) On July 1, 2017, and on each July 1 thereafter, the maximum fee established in paragraph (a) of this subsection (12) is adjusted by the annual percentage change in the United States department of labor, bureau of labor statistics, consumer price index for Denver-Boulder, all items, all urban consumers, or its successor index.

(13) Alcohol and drug evaluation and supervision costs. In addition to any fines, fees, or costs levied against a person convicted of DUI, DUI per se, DWAI, or UDD, the judge shall assess each such person for the cost of the presentence or post sentence alcohol and drug evaluation and supervision services.

(14) Public service penalty. In addition to any other penalties prescribed in this part 13, the court shall assess an amount, not to exceed one hundred twenty dollars, upon a person required to perform useful public service.

(15) If a defendant is convicted of aggravated driving with a revoked license based upon the commission of DUI, DUI per se, or DWAI pursuant to section 42-2-206(1)(b)(I)(A) or (1)(b)(I)(B) , as that crime existed before August 5, 2015:

(a) The court shall convict and sentence the offender for each offense separately;

(b) The court shall impose all of the penalties for the alcohol-related driving offense, as such penalties are described in this section;

(c) The provisions of section 18-1-408, C.R.S ., shall not apply to the sentences imposed for either conviction;

(d) Any probation imposed for a conviction under section 42-2-206 may run concurrently with any probation required by this section; and

(e) The department shall reflect both convictions on the defendant's driving record.

1 Extended to Sept. 1, 2025 by the general assembly in Laws 2016, Ch. 93, § 1, eff. April 14, 2016.

§ 42-4-1402. Careless driving - penalty

(1) A person who drives a motor vehicle, bicycle, electrical assisted bicycle, or low-power scooter in a careless and imprudent manner, without due regard for the width, grade, curves, corners, traffic, and use of the streets and highways and all other attendant circumstances, is guilty of careless driving. A person convicted of careless driving of a bicycle or electrical assisted bicycle shall not be subject to the provisions of section 42-2-127.

(2)

(a) Except as otherwise provided in paragraphs (b) and (c) of this subsection (2), any person who violates any provision of this section commits a class 2 misdemeanor traffic offense.

(b) If the person's actions are the proximate cause of bodily injury to another, such person commits a class 1 misdemeanor traffic offense.

(c) If the person's actions are the proximate cause of death to another, such person commits a class 1 misdemeanor traffic offense.

§ 42-4-1601 Accidents involving death or personal injuries--duties

(1) The driver of any vehicle directly involved in an accident resulting in injury to, serious bodily injury to, or death of any person shall immediately stop such vehicle at the scene of such accident or as close to the scene as possible or shall immediately return to the scene of the accident. The driver shall then remain at the scene of the accident until the driver has fulfilled the requirements of section 42-4-1603(1) . Every such stop shall be made without obstructing traffic more than is necessary.

(1.5) It shall not be an offense under this section if a driver, after fulfilling the requirements of subsection (1) of this section and of section 42-4-1603(1) , leaves the scene of the accident for the purpose of reporting the accident in accordance with the provisions of sections 42-4-1603(2) and 42-4-1606 .

(2) Any person who violates any provision of this section commits:

(a) A class 1 misdemeanor traffic offense if the accident resulted in injury to any person;

(b) A class 4 felony if the accident resulted in serious bodily injury to any person;

(c) A class 3 felony if the accident resulted in the death of any person.

(3) The department shall revoke the driver's license of the person so convicted.

(4) As used in this section and sections 42-4-1603 and 42-4-1606 :

(a) "Injury" means physical pain, illness, or any impairment of physical or mental condition.

(b) "Serious bodily injury" means injury that involves, either at the time of the actual injury or at a later time, a substantial risk of death, a substantial risk of serious permanent disfigurement, or a substantial risk of protracted loss or impairment of the function of any part or organ of the body, or breaks, fractures, or burns of the second or third degree.

§ 18-3-106 Vehicular homicide

(1)

(a) If a person operates or drives a motor vehicle in a reckless manner, and such conduct is the proximate cause of the death of another, such person commits vehicular homicide.

(b)

(I) If a person operates or drives a motor vehicle while under the influence of alcohol or one or more drugs, or a combination of both alcohol and one or more drugs, and such conduct is the proximate cause of the death of another, such person commits vehicular homicide. This is a strict liability crime.

(II) For the purposes of this subsection (1), one or more drugs means any drug, as defined in section 27-80-203(13), C.R.S ., any controlled substance, as defined in section 18-18-102(5) , and any inhaled glue, aerosol, or other toxic vapor or vapors, as defined in section 18-18-412 .

(III) The fact that any person charged with a violation of this subsection (1) is or has been entitled to use one or more drugs under the laws of this state shall not constitute a defense against any charge of violating this subsection (1).

(IV) "Driving under the influence" means driving a vehicle when a person has consumed alcohol or one or more drugs, or a combination of alcohol and one or more drugs, which alcohol alone, or one or more drugs alone, or alcohol combined with one or more drugs affect such person to a degree that such person is substantially incapable, either mentally or physically, or both mentally and physically, of exercising clear judgment, sufficient physical control, or due care in the safe operation of a vehicle.

(c) Vehicular homicide, in violation of paragraph (a) of this subsection (1), is a class 4 felony. Vehicular homicide, in violation of paragraph (b) of this subsection (1), is a class 3 felony.

(2) In any prosecution for a violation of subsection (1) of this section, the amount of alcohol in the defendant's blood or breath at the time of the commission of the alleged offense, or within a reasonable time thereafter, as shown by analysis of the defendant's blood or breath, gives rise to the following:

(a) If there was at such time 0.05 or less grams of alcohol per one hundred milliliters of blood, or if there was at such time 0.05 or less grams of alcohol per two hundred ten liters of breath, it shall be presumed that the defendant was not under the influence of alcohol.

(b) If there was at such time in excess of 0.05 but less than 0.08 grams of alcohol per one hundred milliliters of blood, or if there was at such time in excess of 0.05 but less than 0.08 grams of alcohol per two hundred ten liters of breath, such fact may be considered with other competent evidence in determining whether or not the defendant was under the influence of alcohol.

(c) If there was at such time 0.08 or more grams of alcohol per one hundred milliliters of blood, or if there was at such time 0.08 or more grams of alcohol per two hundred ten liters of breath, such fact gives rise to the permissible inference that the defendant was under the influence of alcohol.

(d) If at such time the driver's blood contained five nanograms or more of delta 9-tetrahydrocannabinol per milliliter in whole blood, as shown by analysis of the defendant's blood, such fact gives rise to a permissible inference that the defendant was under the influence of one or more drugs.

(3) The limitations of subsection (2) of this section shall not be construed as limiting the introduction, reception, or consideration of any other competent evidence bearing upon the question of whether or not the defendant was under the influence of alcohol.

(4)

(a) If a law enforcement officer has probable cause to believe that any person was driving a motor vehicle in violation of paragraph (b) of subsection (1) of this section, the person, upon the request of the law enforcement officer, shall take, and complete, and cooperate in the completing of any test or tests of the person's blood, breath, saliva, or urine for the purpose of determining the alcoholic or drug content within his or her system. The type of test or tests shall be determined by the law enforcement officer requiring the test or tests. If the person refuses to take, or to complete, or to cooperate in the completing of any test or tests, the test or tests may be performed at the direction of a law enforcement officer having probable cause, without the person's authorization or consent. If any person refuses to take or complete, or cooperate in the taking or completing of any test or tests required by this paragraph (a), the person shall be subject to license revocation pursuant to the provisions of section 42-2-126(3), C.R.S . When the test or tests show that the amount of alcohol in a person's blood was in violation of the limits provided for in section 42-2-126(3)(a) , (3)(b) , (3)(d) , or (3)(e), C.R.S ., the person shall be subject to license revocation pursuant to the provisions of section 42-2-126, C.R.S .

(b) Any person who is required to submit to testing shall cooperate with the person authorized to obtain specimens of his blood, breath, saliva, or urine, including the signing of any release or consent forms required by any person, hospital, clinic, or association authorized to obtain such specimens. If such person does not cooperate with the person, hospital, clinic, or association authorized to obtain such specimens, including the signing of any release or consent forms, such noncooperation shall be considered a refusal to submit to testing.

(c) The tests shall be administered at the direction of a law enforcement officer having probable cause to believe that the person committed a violation of subparagraph (I) of paragraph (b) of subsection (1) of this section and in accordance with rules and regulations prescribed by the state board of health concerning the health of the person being tested and the accuracy of such testing. Strict compliance with such rules and regulations shall not be a prerequisite to the admissibility of test results at trial unless the court finds that the extent of noncompliance with a board of health rule has so impaired the validity and reliability of the testing method and the test results as to render the evidence inadmissible. In all other circumstances, failure to strictly comply with such rules and regulations shall only be considered in the weight to be given to the test results and not to the admissibility of such test results. It shall not be a prerequisite to the admissibility of test results at trial that the prosecution present testimony concerning the composition of any kit used to obtain blood, urine, saliva, or breath specimens. A sufficient evidentiary foundation concerning the compliance of such kits with the rules and regulations of the department of public health and environment shall be established by the introduction of a copy of the manufacturer's or supplier's certificate of compliance with such rules and regulations if such certificate specifies the contents, sterility, chemical makeup, and amounts of chemicals contained in such kit.

(d) No person except a physician, a registered nurse, a paramedic as certified in part 2 of article 3.5 of title 25, C.R.S., an emergency medical service provider as defined in part 1 of article 3.5 of title 25, C.R.S., or a person whose normal duties include withdrawing blood samples under the supervision of a physician or registered nurse is entitled to withdraw blood for the purpose of determining the alcoholic or drug content of the blood for purposes of this section. In a trial for a violation of paragraph (b) of subsection (1) of this section, testimony of a law enforcement officer that he or she witnessed the taking of a blood specimen by a person who he or she reasonably believed was authorized to withdraw blood specimens is sufficient evidence that the person was authorized, and testimony from the person who obtained the blood specimens concerning the person's authorization to obtain blood specimens is not a prerequisite to the admissibility of test results concerning the blood specimens obtained. No civil liability shall attach to any person authorized to obtain blood, breath, saliva, or urine specimens or to any hospital, clinic, or association in or for which such specimens are obtained pursuant to this subsection (4) as a result of the act of obtaining the specimens from a person if the specimens were obtained according to the rules prescribed by the state board of health; except that such provision does not relieve the person from liability for negligence in obtaining any specimen sample.

(e) Any person who is dead or unconscious shall be tested to determine the alcohol or drug content of his blood or any drug content of his system as provided in this subsection (4). If a test cannot be administered to a person who is unconscious, hospitalized, or undergoing medical treatment because the test would endanger the person's life or health, the law enforcement agency shall be allowed to test any blood, urine, or saliva which was obtained and not utilized by a health care provider and shall have access to that portion of the analysis and results of any tests administered by such provider which shows the alcohol or drug content of the person's blood or any drug content within his system. Such test results shall not be considered privileged communications and the provisions of section 13-90-107, C.R.S ., relating to the physician-patient privilege shall not apply. Any person who is dead, in addition to the tests prescribed, shall also have his blood checked for carbon monoxide content and for the presence of drugs, as prescribed by the department of public health and environment. Such information obtained shall be made a part of the accident report.

(f) If a person refuses to take, or to complete, or to cooperate in the completing of any test or tests as provided in this subsection (4) and such person subsequently stands trial for a violation of subsection (1)(b) of this section, the refusal to take or to complete, or to cooperate with the completing of any test or tests shall be admissible into evidence at the trial, and a person may not claim the privilege against self-incrimination with regard to the admission of his refusal to take, or to complete, or to cooperate with the completing of any test or tests.

(g) Notwithstanding any provision in section 42-4-1301.1, C.R.S ., concerning requirements which relate to the manner in which tests are administered, the test or tests taken pursuant to the provisions of this section may be used for the purposes of driver's license revocation proceedings under section 42-2-126, C.R.S ., and for the purposes of prosecutions for violations of section 42-4-1301(1) or (2), C.R.S .

(5) In all actions, suits, and judicial proceedings in any court of this state concerning alcohol-related or drug-related traffic offenses, the court shall take judicial notice of methods of testing a person's alcohol or drug level and of the design and operation of devices, as certified by the department of public health and environment, for testing a person's blood, breath, saliva, or urine to determine his alcohol or drug level. This subsection (5) shall not prevent the necessity of establishing during a trial that the testing devices used were working properly and that such testing devices were properly operated. Nothing in this subsection (5) shall preclude a defendant from offering evidence concerning the accuracy of testing devices.

§ 18-3-205 Vehicular assault

(1)

(a) If a person operates or drives a motor vehicle in a reckless manner, and this conduct is the proximate cause of serious bodily injury to another, such person commits vehicular assault.

(b)

(I) If a person operates or drives a motor vehicle while under the influence of alcohol or one or more drugs, or a combination of both alcohol and one or more drugs, and this conduct is the proximate cause of a serious bodily injury to another, such person commits vehicular assault. This is a strict liability crime.

(II) For the purposes of this subsection (1), one or more drugs means any drug, as defined in section 27-80-203(13), C.R.S ., any controlled substance, as defined in section 18-18-102(5) , and any inhaled glue, aerosol, or other toxic vapor or vapors, as defined in section 18-18-412 .

(III) The fact that any person charged with a violation of this subsection (1) is or has been entitled to use one or more drugs under the laws of this state shall not constitute a defense against any charge of violating this subsection (1).

(IV) “Driving under the influence” means driving a vehicle when a person has consumed alcohol or one or more drugs, or a combination of alcohol and one or more drugs, which alcohol alone, or one or more drugs alone, or alcohol combined with one or more drugs affect such person to a degree that such person is substantially incapable, either mentally or physically, or both mentally and physically, of exercising clear judgment, sufficient physical control, or due care in the safe operation of a vehicle.

(c) Vehicular assault, in violation of paragraph (a) of this subsection (1), is a class 5 felony. Vehicular assault, in violation of paragraph (b) of this subsection (1), is a class 4 felony.

(2) In any prosecution for a violation of subsection (1) of this section, the amount of alcohol in the defendant's blood or breath at the time of the commission of the alleged offense, or within a reasonable time thereafter, as shown by analysis of the defendant's blood or breath, gives rise to the following:

(a) If there was at such time 0.05 or less grams of alcohol per one hundred milliliters of blood, or if there was at such time 0.05 or less grams of alcohol per two hundred ten liters of breath, it shall be presumed that the defendant was not under the influence of alcohol.

(b) If there was at such time in excess of 0.05 but less than 0.08 grams of alcohol per one hundred milliliters of blood, or if there was at such time in excess of 0.05 but less than 0.08 grams of alcohol per two hundred ten liters of breath, such fact may be considered with other competent evidence in determining whether or not the defendant was under the influence of alcohol.

(c) If there was at such time 0.08 or more grams of alcohol per one hundred milliliters of blood, or if there was at such time 0.08 or more grams of alcohol per two hundred ten liters of breath, such fact gives rise to the permissible inference that the defendant was under the influence of alcohol.

(d) If at such time the driver's blood contained five nanograms or more of delta 9-tetrahydrocannabinol per milliliter in whole blood, as shown by analysis of the defendant's blood, such fact gives rise to a permissible inference that the defendant was under the influence of one or more drugs.

(3) The limitations of subsection (2) of this section shall not be construed as limiting the introduction, reception, or consideration of any other competent evidence bearing upon the question of whether or not the defendant was under the influence of alcohol.

(4)

(a) If a law enforcement officer has probable cause to believe that any person was driving a motor vehicle in violation of paragraph (b) of subsection (1) of this section, the person, upon the request of the law enforcement officer, shall take, and complete, and cooperate in the completing of any test or tests of the person's blood, breath, saliva, or urine for the purpose of determining the alcoholic or drug content within his or her system. The type of test or tests shall be determined by the law enforcement officer requiring the test or tests. If the person refuses to take, or to complete, or to cooperate in the completing of any test or tests, the test or tests may be performed at the direction of a law enforcement officer having probable cause, without the person's authorization or consent. If any person refuses to take, or to complete, or to cooperate in the taking or completing of any test or tests required by this paragraph (a), the person shall be subject to license revocation pursuant to the provisions of section 42-2-126(3), C.R.S . When the test or tests show that the amount of alcohol in a person's blood was in violation of the limits provided for in section 42-2-126(3)(a) , (3)(b) , (3)(d) , or (3)(e), C.R.S ., the person shall be subject to license revocation pursuant to the provisions of section 42-2-126, C.R.S .

(b) Any person who is required to submit to testing shall cooperate with the person authorized to obtain specimens of his blood, breath, saliva, or urine, including the signing of any release or consent forms required by any person, hospital, clinic, or association authorized to obtain such specimens. If such person does not cooperate with the person, hospital, clinic, or association authorized to obtain such specimens, including the signing of any release or consent forms, such noncooperation shall be considered a refusal to submit to testing.

(c) The tests shall be administered at the direction of a law enforcement officer having probable cause to believe that the person committed a violation of subparagraph (I) of paragraph (b) of subsection (1) of this section and in accordance with rules and regulations prescribed by the state board of health concerning the health of the person being tested and the accuracy of such testing. Strict compliance with such rules and regulations shall not be a prerequisite to the admissibility of test results at trial unless the court finds that the extent of noncompliance with a board of health rule has so impaired the validity and reliability of the testing method and the test results as to render the evidence inadmissible. In all other circumstances, failure to strictly comply with such rules and regulations shall only be considered in the weight to be given to the test results and not to the admissibility of such test results. It shall not be a prerequisite to the admissibility of test results at trial that the prosecution present testimony concerning the composition of any kit used to obtain blood, urine, saliva, or breath specimens. A sufficient evidentiary foundation concerning the compliance of such kits with the rules and regulations of the department of public health and environment shall be established by the introduction of a copy of the manufacturer's or supplier's certificate of compliance with such rules and regulations if such certificate specifies the contents, sterility, chemical makeup, and amounts of chemicals contained in such kit.

(d) No person except a physician, a registered nurse, a paramedic as certified in part 2 of article 3.5 of title 25, C.R.S., an emergency medical service provider as defined in part 1 of article 3.5 of title 25, C.R.S., or a person whose normal duties include withdrawing blood samples under the supervision of a physician or registered nurse is entitled to withdraw blood to determine the alcoholic or drug content of the blood for purposes of this section. In a trial for a violation of paragraph (b) of subsection (1) of this section, testimony of a law enforcement officer that the officer witnessed the taking of a blood specimen by a person who the officer reasonably believed was authorized to withdraw blood specimens is sufficient evidence that the person was authorized, and testimony from the person who obtained the blood specimens concerning the person's authorization to obtain blood specimens is not a prerequisite to the admissibility of test results concerning the blood specimens obtained. No civil liability shall attach to a person authorized to obtain blood, breath, saliva, or urine specimens or to a hospital, clinic, or association in or for which the specimens are obtained in accordance with this subsection (4) as a result of the act of obtaining the specimens from any person if the specimens were obtained according to the rules prescribed by the state board of health; except that the provision does not relieve the person from liability for negligence in obtaining the specimen sample.

(e) Any person who is dead or unconscious shall be tested to determine the alcohol or drug content of his blood or any drug content of his system as provided in this subsection (4). If a test cannot be administered to a person who is unconscious, hospitalized, or undergoing medical treatment because the test would endanger the person's life or health, the law enforcement agency shall be allowed to test any blood, urine, or saliva which was obtained and not utilized by a health care provider and shall have access to that portion of the analysis and results of any tests administered by such provider which shows the alcohol or drug content of the person's blood or any drug content within his system. Such test results shall not be considered privileged communications, and the provisions of section 13-90-107, C.R.S ., relating to the physician-patient privilege shall not apply. Any person who is dead, in addition to the tests prescribed, shall also have his blood checked for carbon monoxide content and for the presence of drugs, as prescribed by the department of public health and environment. Such information obtained shall be made a part of the accident report.

(f) If a person refuses to take, or to complete, or to cooperate in the completing of any test or tests as provided in this subsection (4) and such person subsequently stands trial for a violation of subsection (1)(b) of this section, the refusal to take, or to complete, or to cooperate with the completing of any test or tests shall be admissible into evidence at the trial, and a person may not claim the privilege against self-incrimination with regard to the admission of his refusal to take, or to complete, or to cooperate with the completing of any test or tests.

(g) Notwithstanding any provision in section 42-4-1301.1, C.R.S ., concerning requirements which relate to the manner in which tests are administered, the test or tests taken pursuant to the provisions of this section may be used for the purposes of driver's license revocation proceedings under section 42-2-126, C.R.S ., and for the purposes of prosecutions for violations of section 42-4-1301(1) or (2), C.R.S .

(5) In all actions, suits, and judicial proceedings in any court of this state concerning alcohol-related or drug-related traffic offenses, the court shall take judicial notice of methods of testing a person's alcohol or drug level and of the design and operation of devices, as certified by the department of public health and environment, for testing a person's blood, breath, saliva, or urine to determine his alcohol or drug level. This subsection (5) shall not prevent the necessity of establishing during a trial that the testing devices used were working properly and that such testing devices were properly operated. Nothing in this subsection (5) shall preclude a defendant from offering evidence concerning the accuracy of testing devices.

Chapter 6
State-by-state comparison of DUI/DUID laws

Although the federal government establishes guidelines and some requirements for DUI statutes, states have the primary responsibility for their own DUI laws. This results in a wider variety of variances in DUI laws than some people may realize.

Further information can be found in the following resources:

- www.responsibility.org – Interactive maps display differences among the states in 19 different categories from 24/7 programs to DUID affirmative defense.
- DOT HS 811 236 – A State-by-State Analysis of Laws Dealing With Driving Under the Influence of Drugs. This document, available at https://www.ems.gov/pdf/811236.pdf was published in 2009 so parts of it are now out of date.
- www.stopduid.org – Interactive map provides a more up-to-date version of information in the DOT HS 811 236 document.
- Drug-Impaired Driving: A Guide for What States Can Do – available at https://www.ghsa.org/sites/default/files/2016-11/Drug-Impaired Driving- A Guide For What States Can Do-Interactive.pdf This is published by the Governors Highway Safety Association (GHSA) under the sponsorship of Responsibility.org

All states prohibit drugged driving. Many have specific standards for drugged driving:

Table 13

States	**Laws**
AZ,GA,UT,IL	Zero tolerance for all controlled substances and their metabolites taken illegally. Illinois recently adopted a 5 ng/ml exception for THC
IA, RI	Zero tolerance for all controlled substances. Iowa restricts illegal use only
NC,SD	Zero tolerance for all controlled substances and their metabolites in minors. NC permits medical use. SD applies to minors only.
DE, IN, PA, WI	Zero tolerance for Schedule I and some or all of Schedule II or III drugs taken illegally
KY, MI, OK	Zero tolerance for Schedule I except marijuana, plus 15 other drugs
MN	Zero tolerance for Schedule I drugs except marijuana or Schedule II if taken illegally
NV, OH	Defined *per se* levels of several drugs including THC at 2 ng/ml
VA	Defined *per se* levels of several drugs, THC not included
WA	5 ng/ml for THC, and zero tolerance for THC in minors (ALR only)
MT	5 ng/ml for THC
CO	5 ng/ml permissible inference for THC

States define DUI in various ways including DUI, DUII, DWI, OWI, OUI, with similar meanings for all. There is no standard, but DUI is a widely understood term.

States sometimes statutorily define what DUI means. See Table 14.

Table 14 Impairment definitions

Definition	**Number of states**
Impairment to the slightest degree	3
Impaired, less capable	16
Impaired sufficiently to cause endangerment	1
Ability substantially, materially or appreciably altered	3
Incapable of driving safely	12

Even within these definitions there are variations. Colorado uses the most lenient (from the position of the defendant) definition of "substantially incapable" of safe driving, but has a lower offence of DWAI defined as "affects the person to the slightest degree so that the person is less able" to drive safely.

Vermont uses "impairment to the slightest degree" only for DUID.

Colorado's DWAI has penalties slightly lower than DUI with the notable exception in cases of vehicular homicide and vehicular assault. Whereas vehicular homicide due to DUI is a Class 3 felony and vehicular assault due to DUI is a Class 4 felony, neither vehicular homicide nor vehicular assault due to a DWAI are even misdemeanors.

Colorado has the nation's weakest DUID law

In 2013, Colorado's legislature passed HB 1325 which permitted addicts to drive and established a 5 ng/ml permissible inference limit for THC in whole blood. Like a *per se* law, Colorado's limit makes successful prosecution for DUI extremely unlikely for impaired drivers who test below that limit. As noted in Chapter 3, a minority of drivers arrested for DUI due to marijuana may have a THC blood level above 5 ng/ml. But unlike a *per se* law, a permissible inference law does not guarantee a successful prosecution if the impaired driver tests above that limit.[94] Therefore, Colorado's law is recognized as the weakest DUID law in the nation. See Figure 23.[95]

Figure 23

National Council of State Legislatures. 2017

In part, HB 13-1325 was passed due to the lack of good data and understanding on the part of legislators. The 5 ng/ml limit included in HB 13-1325 emerged from studies in 2004 and 2005.[96] New and better data are now available and more are emerging, so it is incumbent upon legislators to propose and pass wise changes to Colorado's DUI statutes, especially the 5 ng/ml permissible inference limit.

Chapter 8 presents data showing that, like most states, Colorado tests a minority of DUI suspects for drug presence. Washington tests all DUI blood samples for both drugs and alcohol.

Colorado provides a statutory presumption of DUI innocence for drivers testing below BAC .05. This may be appropriate when alcohol is the only intoxicant found, but since drugs compound the effect of alcohol impairment (or perhaps vice versa), a statutory presumption of innocence for a BAC under .05 is not appropriate in cases of polydrug impairment that involve alcohol.

Chapter 7
Model policy proposals

Several national organizations have proposed model DUID policies for states to consider. We present seven here:

- Governors Highway Safety Association
- Institute for Behavior and Health
- NHTSA
- European Traffic Safety Council
- Heritage Foundation
- DUID Victim Voices/We Save Lives
- High Means DUI

Governors Highway Safety Association[97]

1. Add drug-impaired driving messages, especially regarding marijuana- and prescription drug-impaired driving, to their impaired driving campaigns.
2. Consider a campaign with physicians and pharmacists on prescription opioid warnings.
3. Train at least a majority of patrol officers in Advanced Roadside Impaired Driving Enforcement (ARIDE).
4. Seriously consider at least a test of oral fluid devices.
5. Closely follow the development of marijuana breath test instruments and seriously consider a pilot test if and when they become available.
6. Train an adequate number of Drug Recognition Experts (DREs) to address the Driving Under the Influence of Drugs (DUID) problem, consistent with law enforcement resources.
7. Encourage prosecutors and judges assigned to DUID cases to participate in appropriate training.
8. Encourage officers to investigate drug impairment even when alcohol is suspected.
9. Encourage prosecutors to pursue DUID charges when they are supported by the evidence.
10. Authorize electronic search warrants for drug tests. When authorized, law enforcement agencies should implement electronic warrants as needed.
11. Provide appropriate penalties for drug test refusal.
12. Require blood testing for drugs rather than urine testing.
13. Invest in forensic laboratory capabilities to provide adequate testing for drivers arrested for DUID.
14. Test all fatally-injured drivers, and all surviving drivers in a fatal crash who may be at fault, for drugs and alcohol.

15. Establish a separate DUID offense equivalent to DUI. Record suspected and confirmed DUID drivers in arrest and crash records.

Institute for Behavior and Health[98]

1. All states should enact zero tolerance per se DUID legislation.
2. Officers should test every driver whom they suspect is under the influence for drugs, including marijuana, just as they do for alcohol. This includes drivers who test above the illegal 0.08g/dL alcohol limit.
3. Every driver who is involved in a crash involving serious injuries or death should undergo laboratory based (evidential) testing for alcohol and drugs.
4. Law enforcement officers should be permitted to use oral fluid both for data collection purposes and as evidence in legal proceedings.
5. Administrative License Revocation (ALR) should be used for drivers arrested for impairment who fail a drug test or who refuse to provide samples for drug testing.

European Transport Safety Council[99]

1. Legislation
    a. Introduce a zero tolerance system for illicit psychoactive drugs (using the lowest limit of quantification) that takes account of passive or accidental exposure.
    b. Consider the potential ramifications of drug legalisation on drug driving.
    c. Ensure drug driving legislation can be updated to keep track of new illicit drugs.
2. Enforcement
    a. Development by the European Commission of common standards for roadside psychoactive drug driving enforcement.
    b. Increase enforcement levels and penalties for driving under the influence of psychoactive drugs, especially in areas that currently have low levels of enforcement. But this should not be at a cost to drink driving enforcement.
    c. Ensure police forces are properly trained in when and how to perform drug screening (e.g. preselection based on checklist, saliva test, confirmation test) field impairment tests and use of roadside screening devices.
    d. Develop intelligence to enable targeted enforcement for high risk groups, particularly:
        - Young males;
        - Communities where drivers combine consumption of illicit drugs and alcohol and/or multiple illicit drugs;
        - Communities where controlled psychoactive medicines are used to aid driving performance.
3. Education and campaigns
    a. Incorporate drug driving education into school based road safety initiatives, alongside drink driving education.
    b. Target education and campaigns at high risk groups such as young males.

   c. Incorporate the issues relating psychoactive drugs and their effects on driving performance into professional driver education.
4. Rehabilitation and programmes
   a. Integrate rehabilitation schemes in the national countermeasures system.
      - Drug offenders should be treated separately from alcohol offenders.
      - Non-addicts and addicts should be distinguished, as they may require different treatments.
   b. Assessment and rehabilitation should be regulated and criteria based or common standards should be introduced.
   c. Driving licence acquisition for known drug users should be regulated – via the European Driving Licence Directive.
5. Research
   a. Research into the effects of common psychoactive drugs on driving behaviour must continue to ensure countermeasures are fit-for-purpose and keep in line with evolving behaviours.
   b. Research into the effects of new psychoactive substances on driving behaviours is required (e.g. synthetic cannabinoids).
   c. Research into the effectiveness of countermeasures should be carried out.
   d. Continue to invest in development of drug detection technology, including improved duration times and reliability, lower costs for both roadside screening and post-collision testing and laboratory based confirmatory testing.
6. Data collection
   a. Encourage greater and improved monitoring of drug use in traffic to gain more insight into its prevalence, development and trends.
   b. Standardise monitoring methods by establishing a common framework for Member States to use.
   c. Standardise and maximise post-collision data collection.

NHTSA [100]

1. Increase the use of effective and efficient methods for training law enforcement personnel, including drug recognition experts, to detect or measure the level of impairment of a motor vehicle operator who is under the influence of marijuana by the use of technology or otherwise.
2. Continue research to enable development of an impairment standard for driving under the influence of marijuana, and in the meantime, maintain training and other support to enable law enforcement officers and prosecutors to pursue cases using available evidence.
   [Ed note: the poor correlation of THC level in the blood or oral fluid with impairment precludes using THC blood or oral fluid levels as proof of driver impairment.]
3. Encourage States to collect data regarding the prevalence of marijuana use by drivers and among those arrested for impaired driving.
   • States should develop record systems that distinguish among alcohol, drugs, or both for impaired driving cases. These records should be integrated into computerized data

systems of statewide arrest records, the court record systems, and motor vehicle records. One way to accomplish this would be to have separate offenses for driving impaired by alcohol and driving impaired by drugs.

• State records systems should document which drugs are used by drug-impaired drivers.

This information would be helpful for law enforcement, toxicologists, and prosecutors.

• Standard toxicological screening and confirmation procedures should be developed for drug testing laboratories to use in identifying and confirming the presence of drugs that impair driving. These methods should include standard analytic procedures and minimum detection thresholds. There also should be training requirements for the personnel operating these tests.

• State statutes should be amended to provide separate and distinct offenses and sanctions for alcohol- and drug-impaired driving that could be applied individually or in combination to a single case. This would provide an incentive for law enforcement officers to pursue a possible drug-impaired driving charge even when a BAC equal to or above the limit of .08 g/dL has already been established.

Heritage Foundation[101]

1. Apply to every driver under 21-years-old who tests positive for any illicit or impairing drug, including marijuana, the same zero tolerance standard specified for alcohol, the use of which in this age group is illegal.
2. Apply to every driver found to have been impaired by drugs, including marijuana, the same remedies that are specified for alcohol-impaired drivers, including administrative or judicial license revocation.
3. Test every driver involved in a crash resulting in a fatality or a major traffic crash (including injury to pedestrians) for alcohol and impairing drugs, including marijuana.
4. Test every driver arrested for driving under the influence of, or while impaired by, alcohol or drugs for alcohol and impairing drugs, including marijuana.
5. Use reliable oral fluid testing technology at the roadside for every driver arrested for impaired driving.
6. Develop national standardized testing, synchronize the testing with drug overdose testing, and develop a national database that collects the information for program and policy decisions.

DUID Victim Voices/We Save Lives[102]

1. Collect, analyze and publish DUID (Driving Under the Influence of Drugs) data:
   Collect, analyze and publish data to understand the prevalence, causes and consequences of drugged driving. Report the number of DUID citations and causes, and DUID convictions compared to DUI-alcohol. (Recommended by NHTSA and GHSA.)
2. Implement oral fluid testing (both roadside preliminary devices and evidentiary assays):

- Roadside non-quantitative oral fluid testing devices can be used by officers prior to arrest if the officer has *reasonable grounds* to believe that the driver may be impaired by drugs.
  - Results of non-quantitative oral fluid testing shall guide officers in evidence collection.
  - The roadside non-quantitative oral fluid tests results may not be considered evidentiary.
  - Available devices test for drugs including opiates, cocaine, amphetamines, and cannabis.
- Evidentiary laboratory oral fluid testing may be used in lieu of blood evidentiary testing to prove presence of an impairing substance.

3. Provide more DREs, ARIDE-trained officers:

   Provide additional training for and use of Drug Recognition Experts (DREs) and officers trained in Advanced Roadside Impaired Driving Enforcement (ARIDE).
4. Implement mandatory drug testing in the following cases:
   - Preliminary breath alcohol tests <u>and</u> preliminary drug oral fluid tests for all DUI arrests.
   - Evidentiary alcohol and drug tests of all (surviving and deceased) drivers involved in crashes that result in death or serious injuries. Lack of testing ensures DUID remains under-reported.

     In 2016 there were 51,914 drivers involved in fatal crashes that killed 37,461 people. Yet only 15,734 (30.3%) were tested for drugs.
5. Implement eWarrants for blood draws:

   Reduce delays in collecting blood samples through the use of electronic warrants. Traditional warrants can add 1½ hour to the normal two hours required to collect a blood sample in cases of death or serious bodily injury. An average of 73% of marijuana's THC is cleared from the blood within 25 minutes after smoking, making blood test levels irrelevant after such a delay.
6. Enhance penalties for polydrug impairment:

   Enhance penalties for driving under the influence of combinations of drugs or drugs plus alcohol. Combinations of drugs can be more impairing than individual drugs. Enhanced penalties can incentivize and financially support additional drug testing.
7. Adopt responsible DUID legislative options:
   1. Zero tolerance for impairing drugs for drivers under the age of 21.
   2. Tandem *per se* where a driver is guilty of DUID *per se* if the following sequence of events occurs:
      - An officer had probable cause, based on the driver's demeanor, behavior and observable impairment to believe that the driver was impaired; <u>and</u>
      - Proof that the driver had any amount of an impairing substance in blood, oral fluid or breath.

   Sixteen states have zero drug tolerance for drivers, following the Department of Transportation zero drug tolerance policy for commercial drivers and other select employees. These zero tolerance laws vary widely from state-to-state but all are suitable substitutes for Tandem *per se. Per se* limits for drugs are not advised. The impossibility of determining scientifically valid *per se* levels of all scheduled drugs becomes readily apparent when one considers the multiple thousand combinations of drugs that must also be considered.

A 5 ng/ml THC per se law or permissible inference level is NOT a responsible DUID option; most marijuana-impaired drivers test below 5 ng/ml THC in whole blood.

8. Implement 24/7 sobriety programs for chronic alcohol and drug offenders:
   24/7 sobriety programs have proven beneficial for chronic alcohol offenders but are far less common for chronic drug offenders.
9. Impose Administrative License Revocation for drugged driving:
   Drivers' licenses should be revoked administratively for all drivers who either fail preliminary alcohol or drug tests or who refuse to provide biological samples for alcohol or drug testing.

High Means DUI Coalition[103]

Goal

Laws, policies and their enforcement should ensure parity in conviction rates, sentences, and treatment for cases of impaired driving irrespective of cause: alcohol, drugs, or a combination of both. This policy provides guidance to establish laws and policies that deal with the following aspects of drugged driving:

- Enforcement
- Prevention
- Treatment, monitoring, accountability
- Justice for victims

Enforcement

1. Support collection and publication of data for DUID citations and convictions compared to DUI-alcohol.
2. Oppose *per se* limits above zero (0) for THC and other drugs. Instead, the following options are supported:
   a. Tandem *per se*: convict drivers of DUID *per se* after two sequential events:
      i. An officer had probable cause, based on the driver's demeanor, behavior, and observable impairment to believe the driver was impaired, and;
      ii. The driver had any amount of an impairing substance in blood, oral fluid, or breath.
   b. Zero tolerance for drugged driving under the age of 21.
   c. Zero tolerance for THC, illicit drugs, and controlled substances not taken in accordance with a valid prescription.
3. Support mandatory drug testing of blood or oral fluid in all DUI cases.
4. Support mandatory drug testing of all drivers (surviving and deceased) in crashes that result in serious bodily injuries or death.
5. Support forensic laboratories establishing minimum testing policies and capabilities compliant with those set forth in *Recommendations for Toxicological Investigation of Drug-Impaired Driving and Motor Vehicle Fatalities – 2017 Update* (Logan, Lowrie, Turri, et al., Journal of Analytical Toxicology, 2017).

6. Support infrastructure, tools, and training for electronic search warrants to speed access to biological fluids for drug testing.
7. Support enhanced penalties for poly-drug impairment.
8. Support use of roadside preliminary oral fluid drug testing.
9. Support use of evidential oral fluid testing in drug cases.
10. Support administrative license revocation for positive roadside drug tests and/or refusal to provide a biological sample for evidential testing.
11. Support expedited phlebotomy programs, including DUID blood draws by local EMS or officers trained as phlebotomists.
12. Support defining impairment for DUID as “impairment to the slightest degree.”
13. Support defining “drug” in traffic law as “Any substance that, when taken into the human body, can impair the ability of the person to operate the vehicle safely.”
14. Support increased funding for DRE and ARIDE training.

Prevention

1. Support remanding of drivers convicted of DUID to education programs and in addition, as needed to counselling, treatment, and rehabilitation programs.
2. Support State Impairment Task Forces that emphasizes DUID in addition to DUI-alcohol.

Treatment, monitoring, accountability

- Support 24/7 programs for DUI and DUID offenders

Justice for victims

1. Support training and equipping victims’ advocates to service DUID victims as well as DUI-alcohol victims.
2. Provide crash data (including toxicology report) to DUID victims and survivors in a timely manner.
3. Keep victims and survivors informed about the progress of their case in a timely manner.
4. Do everything possible to bring DUID cases to a swift resolution.
5. Treat DUID cases as seriously as DUI-alcohol crashes and crimes.

Part Three – New Data

DCJ report pursuant to HB17-1315 (See separate publication)

Prevalence of drug testing

Annotated bibliography

Chapter 8
Prevalence of drug testing

Proportion of samples tested for drugs

The prevalence of DUID has long been thought to have been underreported because most drivers suspected of impairment are neither assessed for drug impairment at the roadside nor tested for drug presence with laboratory tests. Quantification of this phenomenon has been provided by Jeff Groff of CDPHE, using data reported to CDPHE by forensic laboratories in Colorado for the time period July 1 2015 through June 30, 2016.

		Test samples	% of DUIs
Evidential Samples Tested		20,930	
Evidential Breath Alcohol Tests		9,769	45%
Evidential Blood Alcohol Tests		10,925	52%
CBI	2,302		
Chematox	7,022		
CSU	429		
Denver PD	824		
El Paso Coroner	76		
Horizon Lab	272		
Blood Drug Tests		6,333	30%
CBI	1,590		
Chematox	3,826		
CSU	632		
Denver PD	0		
El Paso Coroner	63		
Horizon Lab	272		
Urine Drug Tests		236	
Chemtox	173		
El Paso Coroner	63		

Post Mortem tests and repeat testing on prosecution samples by defendant are not included. The above numbers do not include those arrested for DUI who refused testing, typically 30%.

Proportion of alcohol samples positive for drugs - Colorado

As noted earlier, when police have sufficient evidence to convict of DUI based upon alcohol, there is no need to test for drugs, and therefore the expense is often not undertaken.

The Colorado State Patrol requested the Colorado Bureau of Investigation to perform a drug screening test on retained samples of blood that previously had proven to be positive for alcohol but not tested for drugs. Results presented at the House Finance Committee hearing for HB 18-1258 on March 19, 2018 by Major Steve Garcia were:

Samples tested	432
Drug positive	71%
Cannabinoid positive	42%

Note: These were immunoassay screening tests, not evidential tests. Cannabinoid positive indicates presence of any cannabinoid, including inactive carboxy-THC.

Blood (or oral fluid) submitted for testing first undergoes a screening test to determine which classes of drugs may be found in the specimen. Usually the screening test is based on immunoassay technology. Immunoassay screening identifies the class of drug, such as cannabinoids or opioids, but not the specific drug like THC or morphine. Immunoassays test for a panel of drugs, usually less than a dozen, and will not detect drugs that are not included in the predetermined panel. Immunoassays provide an identification of the presence of a drug class, with without quantification of the level of the drug class found.

After a drug class presence has been identified from screening, the blood (or oral fluid) is tested again for evidentiary purposes to identify the specific drug in the selected drug class, as well as its concentration. Evidentiary testing is usually done by tandem liquid chromatography – gas chromatography - mass spectrometry (LC/GC-MS).

Proportion of alcohol samples positive for drugs – Wisconsin[104]

A similar study was published in 2018 by the Wisconsin State Laboratory of Hygiene:

Samples tested	116
Drug positive	70%
Cannabinoid positive	52%

Hypothesis

When GHSA released its 2017 update to Drugged-Driving: A Guide to What States Can Do, many in the media reported that drugged driving had surpassed drunk driving, even though that was not the report’s conclusion. The report cited only FARS data, not DUI data.

The reality is likely more complex since it appears that the vast majority of alcohol-impaired drivers were impaired by a combination of alcohol and drugs. FARS and other data already confirm that a large proportion of drugged drivers also tested positive for alcohol, many at levels that could cause impairment.

We are likely faced with a model looking like Figure 24:

Figure 24

With both alcohol and drugs in a driver, one cannot state with certainty which caused the impairment. It's like asking why one likes a Snickers® Bar – is it the chocolate, the nougat, the nuts or the caramel?

It's also not even useful to try. After all, impairment is impairment.

Chapter 9
Annotated recent bibliography (all since 2013)

A refrain heard during testimony for HB13-1325 was, “We need more research.” We would benefit for example, with more research on THC tolerance, addiction, chronic impairment, high dose THC, polydrug use and vaped THC. But we have a great deal more research available now than we did five years ago. Following is an annotated bibliography of relevant research published since 2013. The bibliography includes 27 Reports and 46 Peer-Reviewed Papers and are separated by topic. Chosen reports are of high quality, even though they may not be peer-reviewed.

Reports

Policy recommendations

1. Hedlund J. Drug-Impaired Driving: A Guide For States, GHSA, April 2017 [380]

    Summarizes current state of knowledge on DUID and proposes actions that states can take to reduce drug-impaired driving.

2. Hedlund J. Drug-Impaired Driving: Marijuana and Opioids Raise Critical Issues for States, GHSA, May 2018 [466]

    “States have a critical mission to convince drivers to drive responsibly, alertly, and unimpaired. Marijuana and opioids add different forms of impairment. They require some new tactics to detect impaired drivers, link the impairment to the drug, prosecute and adjudicate offenders, and above all educate drivers and the public. They join with and build on the familiar methods to address alcohol-impaired driving. Impaired driving program focus should not shift to marijuana and opioids but should expand to include marijuana and opioids along with alcohol.” See Chapter 7 for specific recommendations.

3. Berning A, Smither DD. Understanding the limitations of drug test information, reporting and testing practices in fatal crashes. NHTSA Traffic Safety Facts Research Note DOT HS 812 072 November 2014 [231]

    NHTSA cautions against making trend and state comparison DUID inferences based on FARS data due to many limitations of FARS with respect to collecting drug data.

4. Drug use and road safety: a policy brief. Geneva, Switzerland, World Health Organization, 2016. [452]

    General educational pamphlet, copying Elvik [109] (See #36) data and England/Wales drug *per se* standards [257] (See #9).

5. Ramaekers JG. Driving Under the Influence of Cannabis: An Increasing Public Health Concern. JAMA. March 26, 2018 [450]

    "Scientific evidence on the association between cannabis use and driving impairment contrasts with public attitudes toward driving under the influence of cannabis. Regular cannabis users often admit to driving under the influence of cannabis and wrongfully believe that cannabis does not affect their driving performance or that they can compensate for cannabis-associated impairment."

6. Borakove E, Banks R. A Guide to Implementing Electronic Warrants. Justice Management Institute. April 2018 [464]

    A "best practices" guide to implementing eWarrants, supported by the National Sheriffs Association. Electronic warrants can reduce the time delay between an arrest and collecting blood evidence.

<u>Drugged driving reports</u>

7. Lacey J. Drug and Alcohol Crash Risk: A Case-Control Study, NHTSA DOT HS 812 355 (2016) [365]

    This highly controlled study has been widely misrepresented. The authors studied over 3,000 crash drivers and 6,000 controls in Virginia Beach, VA. This report has frequently been cited as proof that THC causes no impairment. The correct interpretation is that the study *failed to find evidence of impairment* from THC <u>or any other drug</u>. *Failure to find evidence is not the same as finding there is no evidence*, especially in a study that was not designed to find the evidence in the first place. Study limitations are described in Chapter 4.

    Richard Compton of NHTSA reported[105] that he is designing a new study to address the concerns that have been brought to his attention about this study.

8. Wallage R. Report on Drug *Per Se* Limits, Canadian Society of Forensic Sciences (CSFS), April, 2017 [402]

    This is an excellent summary of the impairing effects of 9 different drugs, including THC, with a recommendation to the Canadian Parliament for enacting drug *per se* limits prior to legalizing marijuana in Canada. The report was prepared by a team of toxicologists.

    Compare the CSFS recommendations for drug *per se* ng/ml limits with those of the British Expert Panel report in 2013:

Drug	**CSFS**	**England/Wales**
THC	2,5*	2
Cocaine	30	10
Benzoylecgonine	--	50
Heroin	--	--
6-MAM	0	5
Morphine	--	--

Ketamine	0	20
LSD	0	1
Methamphetamine	50	10
Amphetamine	--	250
PCP	0	--
Psilocybin	0	--
GHB	10 mg/L	--

* Not recommended, but considered at the request of the Government.

The Canadian bill to amend their DUI law (Bill C-46) does not establish limits for opioids or benzodiazepines, both problems in Colorado. It establishes two limits for marijuana-impaired driving, the lower “to protect public safety” and the higher to deal with residual THC in marijuana addicts and other heavy users:

- 2 ng/ml THC in whole blood – the driver is subject to a fine
- 5 ng/ml THC in whole blood – the driver may be criminally prosecuted

The bill also provides for possible criminal prosecution if the driver has a blood level of THC greater than 2.5 ng/ml combined with a BAC over .05.

Canada’s Department of Justice issued proposed regulations Oct 14, 2017 incorporating some CSFS recommendations, but lowered cocaine and methamphetamine limits to zero, and GHB to 5 ml/L. It confirmed the government’s commitment to 2 & 5 ng/ml for THC (Canada Gazette Part 1, Vol 151, No 41). In announcing their regulations, the Canadian Department of Justice incorrectly stated that the CSFS report said that a driver testing below 5 ng/ml was not impaired. That was a fabrication by the government, not supported by CSFS.

9. 2014 No 2868 Road Traffic, England and Wales. The Drug Driving (Specified Limits) (England and Wales) Regulation 2014

   DUID *per se* limits in English and Welch law.

10. Wood, E. Brief in opposition to Bill C-46 House of Commons, August, 2017 [400]

    This brief describes the science behind the claim that THC *per se* limits, whether they be 2 ng or 5 ng, are irrational and serve to deny justice to DUID victims. An alternative method, Tandem *per se* was proposed for consideration.

11. Undercounted is Underinvested. National Safety Council Report 2017 [378]

    The Model Minimum Universal Crash Criteria (MMUCC) was proposed to shift from “accident” reporting to crash investigation to learn how to reverse the current trend of increasing traffic fatalities.

Data from Colorado and Washington

12. Monitoring Health Concerns Related to Marijuana in Colorado: 2016, CDPHE [245]

    Pages 145-156 cover Marijuana Use and Driving. This is a good survey of the topic that should be compared with the more comprehensive Hedlund paper (#1). Unfortunately, the CDPHE paper discusses only marijuana, which as noted in Chapter 1 is but a portion of the DUID problem. The authors emphasize the need to collect and monitor the measured ng/ml levels of THC in blood, even though conclusive evidence exists that forensically determined levels of THC bear no relationship to the level of impairment as noted in Chapter 3.

    The DUID section of the report contains the following errors which we have requested be changed in future editions:

    - "Ingesting more than about 15 mg THC is capable of yielding a whole blood THC concentration above 5 ng/ml."

      This statement is not true [See discussion of the Vandry paper in Chapter 3] and ignores the real problem with orally-consumed marijuana: Blood THC levels never rise above 3 ng/ml when consuming marijuana edibles, and that is for someone consuming five times the normal 10 mg THC dose. Therefore it is unlikely that a driver impaired only by edible marijuana could be successfully prosecuted.

    - "Increased risk of driving impairment at blood levels of 2-5 ng/ml."

      This implies a correlation between forensically-determined THC blood levels and levels of impairment, whereas no such correlation exists as described in Chapter 3.

    - "Increased risk of driving impairment at blood levels of 2-5 ng/ml applies only to less-than-weekly users."

      This implies that addicts and other heavy users are not impaired by THC which is not true as described in Chapter 3.

13. The Legalization of Marijuana in Colorado: The Impact, Rocky Mountain HIDTA, Oct 2017 [409]
    - Marijuana-related traffic deaths when a driver was positive for marijuana more than doubled from 55 deaths in 2013 to 123 deaths in 2016. During the same time, all traffic deaths increased 16 percent.
    - In 2009, Colorado marijuana-related traffic deaths involving operators testing positive for marijuana represented 9 percent of all traffic fatalities. By 2016, that number doubled to 20 percent.
    - The report covers only marijuana, not other drugs responsible for DUID. The data above come from NHTSA FARS reports, which is primarily from coroners' tests. Until

2013, NHTSA required that THC and carboxy-THC be categorized together, even though carboxy-THC is the inactive metabolite of THC. Furthermore, NHTSA cautions that a positive marijuana result does not necessarily mean that the driver was impaired by marijuana. None of the cadavers were cited for DUI. NHTSA has cautioned (DOT HS 812 072, November, 2014) against relying upon FARS reports for many drugged driving studies, since FARS was never designed to capture drug data as well as it captures alcohol data.

- Like the CDPHE report, "Monitoring the Health Concerns Related to Marijuana in Colorado," this report deals exclusively with marijuana which limits its usefulness in understanding the broader problem of DUID.

14. Berning A. Marijuana, Other Drugs and Alcohol Use by Drivers in Washington State. NHTSA DOT HS 812 299, July 2016 [347]
    - NHTSA offered to fund this study in Washington and Colorado to establish a baseline prior to implementation of marijuana legalization. Only Washington accepted the offer.
    - This was a voluntary, anonymous roadside study to assess the prevalence of drivers testing positive for alcohol and other drugs, including marijuana. Three time periods were studied: before legalization of marijuana, 6 months after legalization, and 1 year after legalization.
    - The percentage of THC-positive daytime drivers doubled after legalization.
    - Although 41.8% of Washington's marijuana users report using marijuana once a month or less, 24.6% report using marijuana five or more times per week.

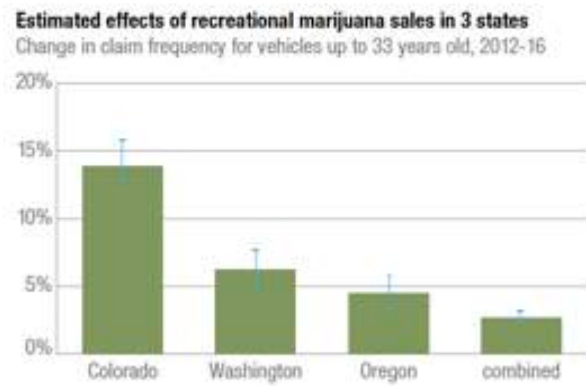
15. Banta-Green C. Cannabis Use among Drivers Suspected of Driving Under the Influence or Involved in Collisions: Analysis of Washington State Patrol Data, AAA Foundation for Traffic Safety, May, 2016 [339]

    The study examined drivers from 2005-2014 involved in collisions and/or arrested for DUI who also had blood evidence. It describes prevalence of THC alone and in combination with alcohol and other drugs, relationship between time to draw blood and THC levels. Lack of data and changes in procedures and staffing made it difficult to evaluate the effect of marijuana legalization. Nevertheless, the findings indicate that THC-involved driving is relatively common, appears to be increasing and is likely underestimated due to the protracted time between incident and the time a blood specimen is obtained to determine drug presence. For drivers arrested following a collision, 11% were positive for THC as well as other substances and an additional 4% were positive for THC only.

16. Migoya D. Traffic fatalities linked to marijuana are up sharply in Colorado: Is Legalization to blame? Denver Post August 25, 2017 [408]

    In 2016, of the 115 drivers in fatal wrecks who tested positive for marijuana use, 71 were found to have Delta-9 tetrahydrocannabinol, or THC, the psychoactive ingredient in marijuana, in their blood, indicating use within hours, according to state data. Of those, 63 percent were over 5 nanograms per milliliter, the state's limit for driving.

17. Stewart K. High claims. Insurance Institute for Highway Safety Vo 52 No 4 June 22, 2017 [396]



Colorado saw the biggest estimated increase in claim frequency compared with its control states. The combined effect for the three states was smaller but still significant at 3 percent. The combined-state analysis is a good representation of the effect of marijuana legalization overall, while the single-state analyses show how the effect can vary from state to state.

18. Grondel D, Hoff S, Doane D. Marijuana Use, Alcohol Use, and Driving in Washington State. Washington Traffic Safety Commission. April 2018 [465]

Washington has done a commendable job collecting and publishing DUID data. They use a single toxicology lab for blood testing all DUI suspects in the state. Since January 1, 2013 the Washington State Patrol lab has been testing all blood samples for both drugs and alcohol. When reporting THC results, they report active THC separately from its inactive metabolite. As advanced as their lab is, they have no means to link test results to judicial outcomes as Colorado is now doing pursuant to HB17-1315.

See Table 3 on page 18 for a data summary. The April 2018 update to their October 2015 WTSC report focuses on polydrug impaired drivers that are now the most prevalent type of impaired drivers involved in fatal crashes. In 2016 the number of polydrug drivers were more than double the number of alcohol-only drivers and five times higher than the number of THC-only drivers involved in fatal crashes.

The report does an excellent job analyzing the varying results from epidemiological studies and is a good complement to the analysis done in Chapter Three of this book.

The report also contains an annotated bibliography that complements the one in Chapter Nine of this book.

On the down side, the report does not cover drugged driving data that does not involve marijuana.

<u>Cannabis reports</u>

19. Logan B. An Evaluation of Data from Drivers Arrested for Driving Under the Influence in Relation to *per se* Limits for Cannabis, AAA Foundation for Traffic Safety, May, 2016 [335]
    - Results of two studies:
      1) a controlled study of 602 drivers arrested for impaired driving in which only THC was present, and
      2) THC and other drugs present in 17,612 DUI cases, 13,988 of which were cannabinoid positive. Full DRE exam reports were assessed in the former study.
      There were minimal DRE performance differences between subjects < 5 ng/ml THC and those ≧5 ng/ml THC.
    - "Based on this analysis, a quantitative threshold for *per se* laws for THC following cannabis use cannot be scientifically supported." 58.3% of 11,328 DUI cases confirmed positive for THC had levels below 5 ng/ml.
    - Marijuana is only one component of a larger DUID problem.

20. Huestis M. Effects of Cannabis With & Without Alcohol on Driving, ACMT Seminar in Forensic Toxicology, Denver, CO, December, 2015 [300]
    - Fatal crash driver culpability risk (Odds Ratio, or OR): Cannabis only, 2.3; Alcohol only, 9.4; Cannabis and Alcohol, 14.1 (From Biecheler 2008 report)
    - *OR for fatal crash is similar for 1-3 ng/ml, 3-5 ng/ml, or >5 ng/ml*
    - 5 ng/ml limit proposal was initially based on 2004-2005 studies
    - 76.5% of Cannabinoid-positive DUI suspects test below 5 ng/ml
    - Driving simulator study – Standard Deviation of Lane Position (SDLP)
      - Only 81.2% of occasional smokers were ever ≧5 ng
      - But 16.7% of frequent smokers were ≧5 ng after 30 hours
      - At 13.1 ng/ml THC driver performance was similar to drivers with BrAC > .08, but that cannot be used to determine a *per se* limit, since in the real world, THC cannot be measured simultaneously with driving.

21. Huestis M. Acute vs Chronic Frequent Cannabis Intake, ACMT Seminar in Forensic Toxicology, Denver, CO, December, 2015 [299]
    - Attempts have been made to determine time of dosing based upon blood test results, but with only limited success.
    - Frequent cannabis smokers can become durably impaired, even after abstinence.

22. Banta-Green C. Overview of Major Issues Regarding the Impacts of Alcohol and Marijuana on Driving, AAA Foundation for Traffic Safety, March, 2016 [325]

    A tabular comparison of alcohol and THC. The differences are so great as to prevent reliance upon DUI-alcohol methods to deal with DUI-THC, such as blood concentrations to determine levels of impairment.

23. Tefft BC, Arnold LS, Grabowski JG. Prevalence of Marijuana Involvement in Fatal Crashes: Washington 2010-2014 May 2016 AAA Foundation for Traffic Safety [337]

    Washington adjusted FARS data by analyzing only THC-positive drivers, not those positive for carboxy-THC. An average of 11.5% of drivers whose blood was tested for drugs between 2010 and 2013 had a THC concentration of 2 ng/mL or greater (range: 10.1% - 12.5%); that proportion increased to 17.1% in 2014.

Oral fluid

24. Logan B. The Science of Oral Fluid Testing and its Current Applications in Drugged Driving Investigation, Interagency Task Force on Drunk Driving, Feb, 2014 [196]
    - Evaluation of 12 roadside oral fluid testing devices, ranking for cut-off, performance, reliability/robustness
    - Three viable options: Dräger DT5000, DrugWipe5, Alere DDS2
    - Sensitivity, Specificity, Accuracy, Positive Predictive Value and Negative Predictive Value for Dräger and DrugWipe devices for all rated drug classes compared with lab-based oral fluid testing
    - *Per se and zero tolerance laws are ineffective and unworkable for THC in states with legal medical or recreational marijuana. Impairment has to be demonstrated and documented, along with signs that relate it to cannabinoid ingestion. Oral fluid testing fulfills that final requirement.*

25. California vs. Salas. Superior Court, Kern County, CA, November, 2015 [352]

    Transcript of Kelly hearing with respect to Dräger DT 5000. Affirms that evidence from the Dräger DT 5000 roadside oral fluid testing device is sufficiently reliable to be admitted to a jury.

26. Anderson W. Oral Fluid Drug Testing in DUID Cases NMS, 2013 [184]
    - This duplicates much of the Logan IATFDD presentation (#20)
    - Compares Dräger sensitivity, specificity and accuracy vs. both oral fluid laboratory testing and vs blood testing
    - Reports results of Los Angeles testing of Dräger device vs. laboratory oral fluid testing, showing excellent sensitivity and specificity; results support DRE opinions but sensitivity was poor for benzodiazepines and some opiates can be missed.

27. Flannigan J, Talpins S, Moore C. Oral Fluid Testing for Impaired Driving Enforcement. The Police Chief. January 2017 [406]

- Article discusses Frye/Daubert requirements for admissibility and recommends use of oral fluid roadside testing devices.
- On-site oral fluid testing devices are not perfect; however, they provide a viable and cost-effective way to identify drugged drivers proximate to the traffic stop. The authors recommend that officers screen all impaired drivers for drugs using on-site devices.

Peer reviewed papers

Policy recommendations

28. Logan BK, D'Orazio AL, Mohr ALA et al. Recommendations for Toxicological Investigation of Drug-Impaired Driving and Motor Vehicle Fatalities - 2017 Update. J Anal Tox, 2018; 42:63-68 [456]

    Recommended Tier I (mandatory) and Tier II (optional) forensic toxicology tests and cutoff limits for blood, urine and oral fluid, for both screening and confirmation.

Drugged driving studies

29. Gjerde H, Strand MC, Mørland J. Driving Under the Influence of Non-Alcohol Drugs – An Update Part I: Epidemiological Studies, *Forensic Science Review* 27:89; 2015 90-112 [287]

    The authors reviewed epidemiological studies published between 1998-2015, finding statistically significant associations between drug use and crashes in the following:

Benzodiazepines	25/28 studies
Cannabis	23/36 studies
Opioids	17/25 studies
Amphetamines	8/10 studies
Cocaine	5/ 9 studies
Antidepressants	9/13 studies

    Generally, studies that did not find significant associations had poor statistical power or poor study design compared to those finding such associations.

30. Strand MC, Gjerde H, Mørland J. Driving Under the Influence of Non-Alcohol Drugs – an Update Part II: Experimental Studies, *Forensic Science Review* 28:79; 2016 80-101 [468]

    The authors reviewed experimental studies published between 1998-2015, finding significant psychomotor impairment after using the following:

    Benzodiazepines
    Cannabis
    Opioids
    GHB

Ketamine

Low doses of stimulants caused inconsistent responses, improving some driving skills but deteriorating others.

31. Bogstrand S. Which drugs are associated with highest risk for being arrested for driving under the influence? A case-control study, *Forensic Science International*, 240 (2014) 21-28 [210]
    - Marijuana-impaired driving is a minor component of a larger DUID problem.
    - A very practical study of 2,738 drivers arrested for DUI compared with 9,375 controls in Norway. Both groups were tested using blood or oral fluid. THC was the most prevalent drug in both groups. Amphetamine/methamphetamine was the most prevalent drug in drivers involved in crashes. Single-use substances that gave the highest odds ratio for police arrest were amphetamine/methamphetamine and benzodiazepines, most due to non-therapeutic use of medicinal drugs purchased on the illegal market. Polydrug use had higher odds ratio than single use drugs and polydrug combinations with amphetamine/methamphetamines or benzodiazepines gave the highest risk.
    - This paper revised the risk classification estimate made in 2011 by the European DRUID conference. Both are shown below for comparison:

Bogstrand – 2014				**DRUID - 2011**		
Arrest risk	**OR**	**Substance**		**Risk level**	**Risk**	**Substance group**
Low	<15	Single use of codeine, diazepam, MDMA, methadone, THC, nitrazepam or zopiclone		Slightly increased risk	1-3	Alcohol <.05 BAC, Cannabis
Medium	15-49	Single use of morphine/heroin or oxazepam. Combinations of THC + one benzo drug.		Medium increased risk	2-10	Alcohol < .08 BAC benzoylecgonine, cocaine, illicit opiates, benzodiazepines and Z-drugs, medicinal opioids
High	50-100	Single use of alprazolam, amphetamine, clonazepam or methamphetamine. Combination of amphetamine /methamphetamine and THC		Highly increased risk	5-30	Alcohol <.12 BAC, alcohol in combination with drugs, Amphetamines
Very high	>100	Combinations of amphetamine /methamphetamine + benzo(s). Two or more medical drugs.		Extremely increased risk	20-200	Alcohol ≧.12 BAC, alcohol in combination with drugs

32. Wood E. DUID prevalence in Colorado's DUI citations, *J of Safety Research*, 2016 [326]
    - Drugged driving was a frequent cause of 2013 DUI citations in cases charged with vehicular homicide or vehicular assault (30%);
    - Polydrug use (19.3%), rather than marijuana alone (1.8%), was the most common cause of drugged driving citations in vehicular homicide and vehicular assault cases;
    - Current warrant procedures render blood tests meaningless in cases of marijuana-impairment.
    - Of the 222 defendants charged with vehicular homicide or vehicular assault, 78.4% were also charged with DUI.

33. Drummer OH, Yap S. The involvement of prescribed drugs in road trauma. Forensic Sci Int'l 2016 Aug; 265: 17-21 [443]

Fatal crash study in Victoria, Australia from 2006 – 2013. Crash risk was elevated for drivers using cannabis (by presence of THC in blood at>2ng/mL) and amphetamines. These data show that drivers using medicinal drugs alone are unlikely to show significant crash risk even if drugs are potentially impairing.

34. Brady JE, Li G. Prevalence of alcohol and other drugs in fatally injured drivers. Addiction 2013 Jan; 108 (1): 104-114 [440]

FARS study 2005-2009. More than half of fatally injured drivers in the United States had been using alcohol or other drugs and approximately 20% had been using polydrugs.

35. Romano E, Pollini R. Patterns of Drug Use in Fatal Crashes. Addiction 2013 August; 108(8) 1428-1438 [442]

FARS analysis 1988-2010. Fatal single vehicle crashes involving drugs are less common than those involving alcohol and the characteristics of drug-involved crashes differ depending upon drug class and whether alcohol is present. Concerns about drug-impaired driving should not detract from the current law enforcement focus on alcohol-impaired driving.

36. Scherer M. Latent Classes of Polydrug Users as a Predictor of Crash Involvement and Alcohol Consumption [475]

This is a companion study to #7 above, and shares some of the same limitations with that study, but makes an important contribution. All polydrug users are not equally risk. The authors identified four classes: marijuana-amphetamines, benzodiazepine-antidepressants, opioid-benzodiazepines, and marijuana-cocaine. Only the opioid-benzodiazepine class were significantly more likely to be involved in a crash.

37. Elvik R. Risk of road accident associated with the use of drugs: a systematic review and meta-analysis of evidence from epidemiological studies. Accid Anal Prev 2013 Nov 60:254-67 [109]

Drug	Crash severity	Best estimate of relative risk adjusted for publication bias	95% confidence interval
Amphetamine	Fatal	**5.17**	(2.56, 10.42)
	Injury	**6.19**	(3.46, 11.06)
	Property damage	**8.67**	(3.23, 23.32)
Analgesics	Injury	1.02	(0.89, 1.16)
Anti-asthmatics	Injury	**1.31**	(1.07, 1.59)
Anti-depressives	Injury	**1.35**	(1.11, 1.65)
	Property damage	1.28	(0.90, 1.80)
Anti-histamines	Injury	**1.12**	(1.02, 1.22)
Benzodiazepines	Fatal	**2.30**	(1.59, 3.32)
	Injury	**1.17**	(1.08, 1.28)
	Property damage	**1.35**	(1.04, 1.76)
Cannabis	Fatal	1.26	(0.88, 1.81)
	Injury	1.10	(0.88, 1.39)
	Property damage	**1.26**	(1.10, 1.44)
Cocaine	Fatal	**2.96**	(1.18, 7.38)
	Injury	1.66	(0.91, 3.02)
	Property damage	1.44	(0.93, 2.23)
Opiates	Fatal	**1.68**	(1.01, 2.81)
	Injury	**1.91**	(1.48, 2.45)
	Property damage	**4.76**	(2.10, 10.80)
Penicillin	Injury	1.12	(0.91, 1.39)
Zopiclone	Fatal	2.60	(0.89, 7.56)
	Injury	1.42	(0.87, 2.31)
	Property damage	**4.00**	(1.31, 12.21)

See #50 for the author's revision of this paper, published comments, and a further re-analysis by the author.

38. Li, Guohua & Brady, Joanne & Chen, Qixuan. (2013). Drug use and fatal motor vehicle crashes: A case-control study. Accident; analysis and prevention. 60C. 205-210. [445]

NHTSA has conducted several roadside surveys of alcohol drug use, beginning in 1973. For the first time in 2007, the survey also included studies of illegal drugs, prescription drugs and over-the-counter medicines. 10,909 drivers were randomly stopped at 300 sites across the nation for a volunteer survey. 7,719 volunteered to participate and to provide oral fluid drug testing samples. These constituted the controls in this case-control study.

The 737 study subjects were FARS fatalities in the continental US at the same times and dates as the control samples. Study subjects had drug testing done on blood samples.

Drug prevalence and Odds Ratios of drug classes were determined, as well as Odds Ratios of drug positive, alcohol positive and positive for both. Alcohol presence was rated as positive if the BAC was .01 gm/dL or higher.

Prevalence of drugs detected and crude Odds Ration and 95% Confidence Intervals of fatal crash involvement according to drug category, in the continental United States, selected time periods on Fridays and Saturdays, July 20 through December 1, 2007.

Drug Category	% of Cases (n=737)	% of Controls (n=7719)	Crude OR[a]	95% CI
Marijuana	9.8	5.6	1.83	1.39, 2.39
Narcotics	4.8	1.6	3.03	2.00, 4.48
Stimulants	9.4	2.8	3.57	2.63, 4.76
Depressants	5.2	1.1	4.83	3.18, 7.21
Polydrug[b]	7.1	2.2	3.41	2.43, 4.73

OR=Odds Ratio; CI=Confidence Interval;

[a] Drivers who tested negative for the specific drug category were used as the reference group;

[b] Two or more non-alcohol drugs.

Estimated Odds Ratios and 95% Confidence Intervals of fatal crash involvement according to alcohol and drug testing results, the continental United States, selected time periods on Fridays and Saturdays, July 20 through December 1, 2007.

Testing Result			
Alcohol	Drug	Estimated OR	95% CI
Negative	Negative	1.00	Reference
Positive	Negative	13.64	11.12, 16.72
Negative	Positive	2.22	1.68, 2.92
Positive	Positive	23.24	17.79, 30.28

OR=Odds Ratio; CI=Confidence Interval;

Marijuana was the most common drug found in fatal crashes, followed by stimulants (e.g. cocaine, methamphetamine), and polydrug. Depressants (e.g. benzodiazepines) had the highest odds ratio, followed by stimulants and polydrug. Marijuana's odds ratio was the lowest of the categories at 1.83.

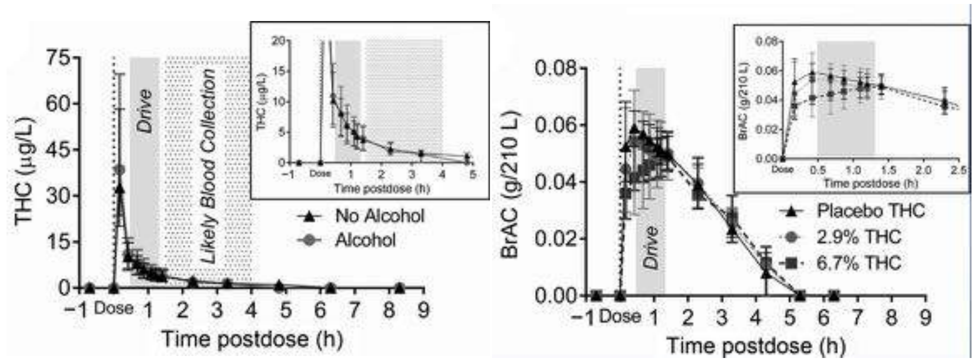
Drivers positive for drugs and alcohol had nearly double the OR of drivers positive for alcohol alone.

Cannabis studies

39. Hartman R. Cannabis effects on driving lateral control with and without alcohol, *Drug and Alcohol Dependence*, (2015) [278]

This is a study of 18 occasional marijuana smokers using the high fidelity, full-motion driving simulator in Iowa. The study found that both cannabis and alcohol increased SDLP, a measure of lane weaving. "Blood THC concentrations of 8.2 and 13.1 ng/ml … increased SDLP similar to .05 and .08 BAC." The authors cautioned, "In authentic DUIC cases, measured THC concentrations do not reflect those present during driving," indicating that these levels cannot be used as *per se* legal limits.

40. Hartman R. Effect of Blood Collection Time on Measured Δ9-Tetrahydrocannabinol Concentrations: Implications for Driving Interpretation and Drug Policy, *Clinical Chemistry*, 62:2 367-377 (2016) [322]



This paper was written partially in response to inaccurate media reporting of the results of the above author's Iowa driving simulator study. Forensically-determined THC levels cannot indicate THC levels at the time of the incident leading to an arrest for DUI. 18 subjects were tested with both alcohol and vaporized THC. THC levels dropped an average of 73% within 25 minutes after beginning inhalation (range 3.3% - 89.5%), and 90% an hour later. Alcohol, on the other hand is cleared from blood much more slowly and retrograde extrapolation can be employed if needed. So forensically-determined alcohol levels can indicate alcohol levels at the time of the incident. This cannot be done with THC.

41. Wood E. Delays in DUI blood testing: Impact on cannabis DUI assessments, *Traffic Injury Prevention,* 2016 [269]

Average time from law enforcement dispatch to blood draw in cases of vehicular homicide and vehicular assault was 2.32 hours. With such delays, blood testing in these cases would be unlikely to confirm that drivers who are impaired have THC levels above 5 ng/ml.

42. Urfer S. Analysis of Δ9-tetrahydrocannabinol Driving Under the Influence of Drugs Cases in Colorado from January 2011 to February 2014, *J of Analytical Toxicology*, 2014 [223]
    - The percentage of law enforcement cases requesting cannabinoid screens increased from 28% to 35%.
    - The percent of cannabinoid screens positive for THC was 62%, with no significant change over the years.
    - The percent of positive cannabinoid screens confirmed positive at or above 2 ng/ml increased significantly from 28% to 65%.
    - The median time between traffic stop and time of draw was 1.05 hours for cases with positive cannabinoids.

43. Vandrey R. Pharmacokinetic Profile of Oral Cannabis in Humans: Blood and Oral Fluid Disposition and Relation to Pharmacodynamic Outcomes, *J of Analytical Toxicology*, Feb 2017 [381]

- After 10, 25 or 50 mg THC doses of marijuana edibles, THC levels in blood never reached 5 ng/ml for any of the 18 subjects tested, even though all subjects claimed the doses affected them and some were so affected by THC that two vomited and one could not complete any assessments. Two subjects completed the study with no detectable THC blood levels after 10 mg doses.
- *Blood THC levels are useless to determine impairment or even presence of THC when the source of the THC was an edible.*

44. Hartman R. Drug Recognition Expert (DRE) examination characteristics of cannabis impairment, *Accident Analysis and Prevention*, 92 (2016) 219-229 [330]
    - This is a very important study that confirmed the concern raised by Papafotiou and others in 2005 that Standardized Field Sobriety Tests (SFSTs) designed to test and confirm alcohol impairment, are only modestly successful in confirming marijuana impairment. This study was undertaken in cooperation with NIH and the International Association of Chiefs of Police to determine reliable metrics to identify cannabis-driving impairment.
    - DRE exams were done on 302 cannabis-only DUI cases from 2009-2014 from 9 states including Colorado (14 cases, including 5 with a red card), compared with 302 controls. The following combination of tests resulted in >96.7% sensitivity, specificity, positive and negative predictive value and efficiency to identify marijuana impairment: ≧2/4 of: ≧3 FTN misses, MRB eyelid tremors, ≧2 OLS clues, ≧2 WAT clues. The most common reason to pull over a driver was speeding. Only one was driving too slowly. *There was no significant difference in either violations or test scores between drivers who tested above or below 5 ng/ml THC.*

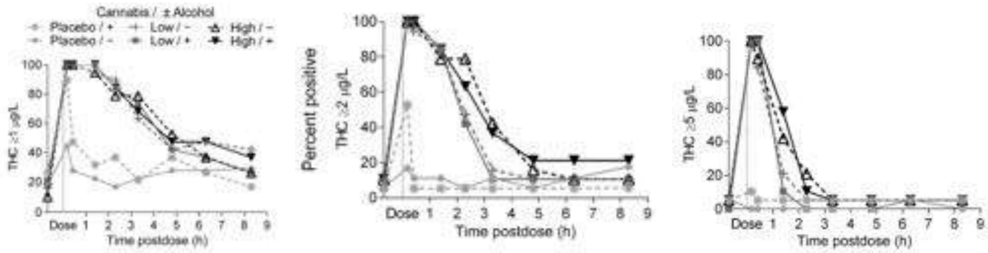
45. Declues K. A 2-Year Study of Δ 9-tetrahydrocannabinol Concentrations in Drivers: Examining Driving and Field Sobriety Test Performance, *J of Forensic Sciences*, Nov 2016 [367]
    - *No correlation between performance on field sobriety tests (SFST) and blood THC concentration was found in the range between 2 ng/ml and 30 ng/ml.*
    - Average time between first law enforcement contact and blood draw was 2.5 hours unless a DRE evaluation was required, in which case the average was 3.2 hours.
    - The most common causes for apprehending a marijuana-impaired driver were speeding and inability to maintain lane position.

46. Bosker W. Psychomotor Function in Chronic Daily Cannabis Smokers during Sustained Abstinence, *PLOS One*, 2013 [122]

    Performance on critical tracking and divided attention was assessed in 19 chronic, daily marijuana smokers during 21 days of continuously monitored abstinence, using non-intoxicated occasional marijuana users as controls. At baseline, chronic users were significantly impaired compared to controls (p<.001). *Performance improved over three weeks, but did not recover to the equivalent performance of the control group.*

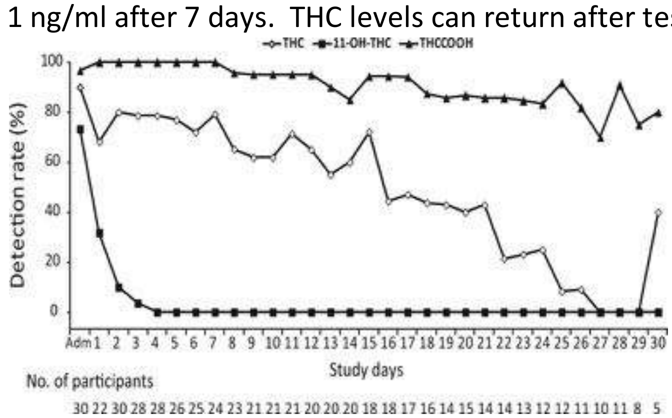
47. Hartman R. Controlled Vaporizer Administration: Blood and Plasma Cannabinoids with and without Alcohol, *Clinical Chemistry,* 61:6 850-869 (2015) [277]

Tested 19 subjects with both alcohol and vaporized THC, measuring THC in whole blood after dosing. After 2 hrs, only 20% of subjects exceeded 5 ng/ml, 80% exceeded both the 2 ng/ml and 1 ng/ml cutoff limits. Some subjects exceeded all cutoff limits after using only placebo.



48. Bergamashi M. Impact of Prolonged Cannabinoid Excretion in Chronic Daily Cannabis Smokers' Blood on Per Se Drugged Driving Laws, *Clinical Chemistry*, 2013 [118]

Thirty chronic daily marijuana smokers (median 9 joints per day) had daily cannabinoid blood tests while residing on a restricted facility to prevent further use of marijuana. Cannabinoids can be detected in the blood of chronic users during one month of sustained abstinence. Positive results were obtained using research laboratory methods that reported positive THC above 0.25 ng/ml, compared with 1 ng/ml for most US forensic laboratories. All subjects had THC ≤ 1 ng/ml after 7 days. THC levels can return after testing negative.



49. Couper F. The Prevalence of Marijuana in Suspected Impaired Driving Cases in Washington State., *J of Analytical Toxicology*, 2014;38:569-574 [383]

Positive THC blood tests in DUI cases increased from 19.1% to 24.9% between pre & post legalization, but before licensure of commercial recreational marijuana establishments. Since 2013, all blood samples were drug tested for amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine metabolite, methadone, opiates, phencyclidine, propoxyphene and tricyclic antidepressants, not just for alcohol. 47% of confirmed positive THC cases tested below 5 ng.

50. Davis K, Allen J, Duke J, et al. Correlates of Marijuana Drugged Driving and Openness to Driving While High: Evidence from Colorado and Washington. PLoS One v.11(1); 2016: e0146853 [455]

“Increased perceptions that driving while high is unsafe was associated with significantly lower willingness to drive after using marijuana while increased knowledge of marijuana DUI laws was not associated with these outcomes.”

51. Rogeberg O, Elvik R. The effects of cannabis intoxication on motor vehicle collision revisited and revised. Addiction 111, 1348-1359 (2016); Gjerde H, Morland J. Risk for involvement in road traffic crash during acute cannabis intoxication. Addiction. 2016;111(8):1492-1495; Rogeberg O, Elvik R. Response: cannabis intoxication, recent use and road traffic crash risks Addiction. 2016;111(8):1495-1498 [423] [453] [454]

“Acute cannabis intoxication is associated with a statistically significant increase in motor vehicle crash risk.” Authors recalculated estimates from 18 other studies and determined the overall OR to be 1.35 with a random-effects model.

If 2/3 of subjects in the studies were not impaired, that would imply an OR for acutely impaired drivers to be 2.1, according to Rogeberg. “We find that the average OR of acutely intoxicated drivers is unlikely to be substantially above 2.”

52. Newmeyer MN, Swortwoot MJ, Barnes AJ et al. Free and Glucuronide Whole Blood Cannabinoid's Pharmocokinetics after Controlled Smoked, Vaporized, and Oral Administration in Frequent and Occasional Users: Identification of Recent Cannabis Uptake. Clinical Chemistry 62:12 1579-1592 (2016) [437]

Cannabigerol and Cannabinol are recent use cannabis markers after cannabis inhalation, but their absence does not exclude recent use.

53. Lemos NP, San Nicolas AC, Volk JA et al. Driving Under the Influence of Marijuana vs Driving and Dying Under the Influence of Marijuana: A Comparison of Blood Concentrations of Δ9 THC and Other Cannabinoids in Arrested vs Deceased Drivers. J Anal Tox 2015; 39:588-601 [434]

The analysis of variance between living and deceased drivers’ cannabinoid concentrations showed that THC-OH and THC-COOH concentrations are not statistically different between the two groups, but that THC concentrations are statistically different, making it difficult to directly correlate PM with antemortem THC concentrations between living and deceased drivers.

54. Santaella-Tenorio J, Mauro CM, Wall MM et al. US Traffic Fatalities, 1985-2014, and Their Relationship to Medical Marijuana Laws. Am J Public Health (2017) 107: 336-342 [422]

Analyzed FARS data from 1985-2014. “On average, MML states had lower traffic fatality rates than non-MML states. However, state-specific results showed that only 7 out of 23 states experienced post-MML reductions.”

"Total traffic fatalities" is a very blunt tool to measure the impact of medical marijuana laws. State variations in FARS reporting minimizes the validity of studies such as this. See Martin, #57.

55. Aydelotte JD, Brown LH, Luftman KM et al. Crash fatality rates after recreational marijuana legalization in Washington and Colorado. Am J Public Health (Aug 2017) 107 (8) 1329-1331 [421]

    Compared FARS data from 2009 – 2015 for WA and CO compared to 8 states without either legal or recreational or medical marijuana. "Three years after recreational marijuana legalization, changes in motor vehicle crash fatality rates for Washington and Colorado were not statistically different from those in similar states without recreational marijuana legalization."

    Aydelotte et al. found that since legalization, the fatality rate change per year *rose* in Colorado and Washington by 0.3 fatalities per Billion Vehicle Miles Traveled (BVMT), whereas the rate change per year *dropped* in the comparison states by 0.8, a difference of 1.1 fatalities/ BVMT. Since the comparison states weren't identical to Colorado and Washington in many respects, the authors applied 9 adjustment factors to their raw data including 3 for economic health and 3 for congestion. The effect of these adjustments was to lower the difference in fatalities/BVMT by over 80% to 0.2 fatalities/BVMT.

    After factoring in their adjustments, the authors estimated Colorado and Washington had 77 excess crash fatalities over nearly 38 million person-years of exposure. They commented, "We do not view that as a clinically significant effect, but others might disagree."

    Presumably the 77 "excess crash fatalities" would disagree, had they survived.

56. van Wel JHP, Kuypers KPC, Theunissen EL et al. Single doses of THC and cocaine decrease proficiency of impulse control in heavy cannabis users. Brit J of Pharmacology (2013) 170; 1410-1420 [419]

    "Heavy cannabis users display impairments in a broad range of neuropsychological domains during THC intoxication. Impairments observed in psychomotor tasks, but not in impulsivity tasks, appeared smaller in magnitude as compared with those previously reported in occasional cannabis users. The reduction in proficiency in impulse control may put drug users at increased risk of repeated drug use and addiction."

57. Desrosiers NA, Ramaekers JG, Chaucchard E. Smoked Cannabis' Psychomotor and Neurocognitive Effects in Occasional and Frequent Smokers. J Anal Tox 2015; 39: 251-261 [416]

    "Occasional smokers had significantly more difficulty compensating for Critical Tracking Task tracking error compared with frequent smokers 1.5 h after smoking. Divided attention performance declined significantly especially in occasional smokers. Cannabis smoking impaired psychomotor function, more so in occasional smokers, suggesting some tolerance to psychomotor impairment in frequent users."

58. Martin JL, Gadegbeku B, Wu D. Cannabis, alcohol and fatal road accidents. PLOS One (2017) 12(11) : e0187320. [414]

    A study of 4,059 French drivers in 2011. "Drivers under the influence of cannabis multiply their risk of being responsible for causing a fatal accident by 1.65 (1.16-2.34), and the proportion of fatal accidents which would be prevented if no drivers ever drove under the influence of cannabis is estimated at 4.2% (3.7%-4.8%)."

59. Li, G. Role of alcohol and marijuana use in the initiation of fatal two-vehicle crashes, Annals of Epidemiology, 2017 [393]

    Data on 14,742 culpable and 14,742 nonculpable drivers in the same fatal two-vehicle crashes were assessed for association of driver use of alcohol, marijuana or both with fatal crash initiation, adjusting for demographic variables. Marijuana *alone* had an OR of 1.62 alcohol *alone* had an OR of 5.37 and both combined had an OR of 6.39. Conclusion – both marijuana and alcohol increase the likelihood of a crash, with alcohol being much more dangerous. The combination of the two increases the OR by less than the OR of marijuana times the OR of alcohol.

60. Chihuri S, Li G, Chen Q. Interaction of marijuana and alcohol on fatal motor vehicle crash risk: a case-control study. Injury Epidemiology (2017) 4:8 [410]

    Using 2006-2009 FARS for 1,944 study subjects compared to 7,719 controls from the 2007 National Roadside Survey, authors four O.R. for fatal crashes were 1.54 for cannabinoids, 16.33 for alcohol and 25.09 for both combined.

61. Bondallza P, Favrat B, Chtioui H et al. Cannabis and its effects of driving skills. Forensic Sci Int'l 268 (2016) 92-102 [386]

    Swiss literature review, incorporating results from the DRUID study. "Results presented in this review show a cannabis-induced impairment of actual driving performance by increasing lane weaving and mean distance headway to the preceding vehicle. Acute and long-term dose-dependent impairments of specific cognitive functions and psychomotor abilities were also noted, extending beyond a few weeks after the cessation of use. Although the correlation between blood or oral fluid concentrations and psychoactive effects of THC needs a better understanding, blood sampling has been shown to be the most effective way to evaluate the level of impairment of drivers under the influence of cannabis. The blood tests have also shown to be useful to highlight a chronic use of cannabis that suggests an addiction and therefore a long-term unfitness to drive.

62. Wettlaufer A, Florica R, Asbridge M et al. Estimating the harms and costs of cannabis-attributable collisions in the Canadian provinces. Drug and Alcohol Dependence 173 (2017) 185-9190 [372]

    "Cannabis-attributable traffic collisions were estimated to have caused 75 deaths (95% CI: 0–213), 4,407 injuries (95% CI: 20–11,549) and 7,994 people (95% CI: 3107–13,086) were involved in property damage only collisions in Canada in 2012, totaling $1,094,972,062 (95% CI: 37,069,392–2,934,108,175) with costs being highest among younger people."

63. Sewell RA, Schnakenber A, Elander J et al. Acute effects on THC on time perception in frequent and infrequent cannabis users. Psychopharmacology (Berl) 2013 Mar 226 (2) 401-413 [351]

    A psychoactive dose of THC increases internal clock speed as indicated by time overestimation and underproduction. This effect is not dose-related, and is blunted in chronic cannabis smokers, who did not otherwise have altered baseline time perception.

64. Ramaekers JG, van Wel JH, Spronk DB. Cannabis and tolerance: acute drug impairment as a function of cannabis use history. Scientific Reports Nature 6: 26843 (2016) [344]

    Executive function, impulse control, attention, psychomotor function and subjective intoxication were significantly worse after cannabis administration relative to placebo. Cocaine improved psychomotor function and attention, impaired impulse control and increased feelings of intoxication. Acute effects of cannabis and cocaine on neurocognitive performance were similar across cannabis users irrespective of their cannabis use history. Absence of tolerance implies that that frequent cannabis use and intoxication can be expected to interfere with neurocognitive performance in many daily environments such as school, work or traffic.

Oral fluid

65. Kelly-Baker T. Comparing Drug Detection in Oral Fluid and Blood: From a National Sample of Nighttime Drivers, *Traffic Injury Prevention*, 2013 [260]

    "Oral fluid can be considered a reliable alternative to blood as a matrix for drug testing." Drug concentrations are typically higher in oral fluid than in blood.

66. Hartman R. Controlled vaporized cannabis, with and without alcohol: subjective effects and oral fluid-blood cannabinoid relationships, *Drug Testing and Analysis*, 2015 [311]

    Tested 18 subjects with both alcohol and vaporized THC. Oral fluid THC concentrations correlated ($p<0.001$) with blood THC concentrations, but they were not equal.

67. Logan B. Detection and Prevalence of Drug Use in Arrested Drivers Using the Dräger Drug Test 5000 and Affiniton DrugWipe Oral Fluid Drug Screening Devices, *J of Analytical Toxicology*, 2014; 1-7 [211]

Tested 91 suspects arrested for DUI in Miami, FL using two roadside oral fluid testing devices and confirmed by oral fluid and urine laboratory confirmation. Sensitivity, specificity and accuracy were determined for both devices for all drugs tested. The most frequently detected drugs were cannabinoids (30%), benzodiazepines (11%), and cocaine (10%). Of drivers with BAC>.08, 39% were also drug positive. Both devices performed comparably, but the Dräger device was more sensitive in detecting THC. The devices were less effective detecting benzodiazepines. Sensitivities were adequate (50-60%), with very high specificity (>96%).

68. Hartman R. Cannabinoid disposition in oral fluid after controlled vaporizer administration with and without alcohol, *Forensic Toxicology*, (2015) [276]

Oral fluid tested by Dräger DT 5000 and Quantisal laboratory assay after vaporized THC (2.9% and 6.7%). Oral fluid THC content was similar with both strengths of THC preparations, indicating likely self-titration. Concurrent alcohol did not affect oral fluid concentrations or Dräger sensitivity. With a THC confirmation cutoff of 5 ng/ml, Dräger sensitivity, specificity and efficiency were 60.8, 98.2, and 82.5%.

69. Van der Linden T. Roadside drug testing: Comparison of two legal approaches in Belgium, *Forensic Science International*, 249 (2015) 148-155 [261]

Belgium changed its DUID laws in 2009 from relying upon roadside impairment tests and roadside urine testing to roadside tests of recent drug use and roadside oral fluid testing (DrugWipe). They also cut drug *per se* limits for all drugs. For example, THC limits are now 1 ng/ml in plasma. The changes resulted in greater efficiency in DUID assessments and lower false positives that were detected upon confirmatory testing. For example, false positives for THC dropped from 24.8% to 8.6%, even though the advertised sensitivity of the Drugwipe device in 2009 was 20 ng/ml THC in oral fluid. The DrugWipe sensitivity has since been increased.

70. Langel K, Gjerde H, Favretto D et al. Comparison of drug concentrations between whole blood and oral fluid. Drug Testing and Analysis Sept 2013 V 6 No 5 pp 461-471 [441]

Studied DUI arrestees and volunteers in four countries to determine oral fluid:whole blood concentration ratios for amphetamines 19-22, opioids 1.8-11, cocaine and metabolites 1.7-17, THC 14, benzodiazepines .035-.33. For all substances, except for lorazepam (R = 0.031) and THC (R = 0.030), a correlation between the oral fluid and whole blood concentrations was observed. Due to large variations seen here, drug findings in oral fluid should not be used to estimate the corresponding concentrations in whole blood (or vice versa). However, detection of drugs in oral fluid is a sign of recent drug use.

71. Gjerde H, Clausen GB, Andreassen E et al. Evaluation of Dräger Drug Test 5000 in a Naturalistic Setting. J Anal Tox 2018; 1-7 [436]

Results of Norwegian use of DT5000 since 2015. In cases with false-positive DDT5000 results compared to blood, traces of drugs were most often found in oral fluid. The DDT5000 did not absolutely correctly identify DUID offenders due to fairly large proportions of false-positive or false-negative results compared to drug concentrations in blood. The police reported that DDT5000 was still a valuable tool in identifying possible DUID offenders, resulting in more than doubling the number of apprehended DUID offenders.

72. Beirness DJ, Smith DR. An assessment of oral fluid drug screening devices. Canadian Society of Forensic Science Journal 2016 [364]

The Alere DDS 2®, Dräger DrugTest 5000® and Securetec DrugWipe 6S® devices were evaluated. Sensitivity exceeded 0.80 for cannabis, cocaine, methamphetamine, and opioids. False positive rates for these drugs/drug categories were all between 3% and 7%. Specificity exceeded 0.90 for all drugs/drug categories. These findings indicate that oral fluid screening could prove to be a valuable tool in the detection of driver drug use in Canada.

73. Hartman RL, Anizan S, Jang M et al. Dräger DrugTest 5000 On-Site Fluid Cannabinoid Screening Performance after Cannabis Vaporization [361]

The DDT-5000 demonstrated good specificity and efficiency for OF obtained after cannabis vaporization, but sensitivity was lower than after smoking a cannabis cigarette with the same THC potency (sensitivity 90.7% at THC≥2, Desrosiers *Clin Chem* 2012). Volatilization by hot air is a different heating mechanism than combustion, altering the properties of inhaled vapor versus smoke. Dräger collection involves moving the device throughout the entire mouth, whereas Quantisal devices are held sublingually. These and other factors may contribute to the observed sensitivity differences relative to smoking.

Quantitative Confirmation Cutoffs µg/L (THC) ng/L (THCCOOH)	**Sensitivity %**	**Specificity %**	**Efficiency %**	**Median [Range] t_{last} (h) Low[a], High[b]**	***p*-value (Low vs. High)**
THC ≥5	61.4	98.1	82.5	3.33[a,b] [0.17-≥8.33]	ns
THC ≥2	48.0	99.6	70.4	3.33[a,b] [0.17-≥8.33]	ns
THC ≥1	41.4	99.8	61.4	3.33[a,b] [0.17-≥8.33]	ns
THC ≥2+THCCOOH ≥20	49.5	81.4	72.4	3.33[a] [0.17-≥8.33] 3.83[b] [1.43-≥8.33]	ns
THC ≥1+THCCOOH ≥20	45.6	80.8	70.1	3.33[a] [0.17-≥8.33] 3.83[b] [1.43-≥8.33]	ns

Part Four

Recommended Changes

Colorado DUID victims: the impact of Colorado's laws

Colorado recommended changes

Rationale for recommendations

Chapter 10
Colorado DUID victims: the impact of Colorado's laws

Following are accounts of dozens of Colorado DUID victims taken from court records, the words of the victims or their next of kin. After each story are changes to Colorado DUID laws that are recommended to address the issues discussed in each story. Refer to Chapters 11 and 12 for a discussion on the meaning of "Tandem *per se.*"

Steve and Patty Smith

Steve and Patty Smith were driving from Denver to their home in Wyoming in 2013 when Landra Fabrizius crossed into their lane at 80 MPH, killing them instantly. Fabrizius was also injured, which is why the Drug Recognition Expert at the scene was unable to complete a DRE assessment to confirm that she had been driving under the influence of drugs. DRE assessments of Romberg balance, Walk and turn, One leg stand and Finger to nose require that a subject be able to stand.

What evidence the DRE was able to collect convinced him that Fabrizius was DUID so, after conferring with his supervisor, he ordered the collection of a vial of blood. The blood was collected 5 hours after the collision. That length of delay is not unusual in fatal collisions, and is critical, since, unlike alcohol, drugs metabolize in a rapid, geometric rate. Fabrizius was charged with two counts of vehicular homicide and DUID.

Fabrizius's blood was tested and confirmed to contain 48 ng/ml of methamphetamine at the time of collection. Who knows how high it was at the time of collision?

The judge refused to allow admission of the laboratory evidence, on the grounds that the officers at the scene had no probable cause to collect the blood. With inadequate evidence that Fabrizius was on drugs, she escaped a DUID conviction.

Fabrizius was found guilty of two counts of vehicular homicide due to reckless driving, a Class 4 felony, and sentenced May 17, 2011 in Greeley to five years per homicide. Had Fabrizius been found guilty of vehicular homicide due to DUID, a Class 3 felony, her presumed sentencing range would have been double what she received.

Recommendation: Mandatory admissible drug testing or all drivers in all crashes that result in death or serious bodily injury. Tandem per se.

Keri Phillips

On June 20, 2014 Keri was hit head-on by a 24-year old drug impaired driver whose license had been suspended due to prior DUI charges. At the time, Keri was on her way to play flute at the ordination mass for a priest at her church in Pueblo.

Keri sustained bruises, burns from the explosive charge of the air bag, a concussion and a shattered right knee cap. The surgeon was able to reconstruct about two-thirds of the knee cap; the rest was the consistency of sand.

Concerned citizens that initially reported the driver as a suspected DUI followed him and recorded his reckless driving with a cell phone camera all the way to the collision. The driver agreed to a voluntary blood draw which confirmed the presence of marijuana and opiates including morphine.

He was charged with DUI and vehicular assault due to DUI (Class 4 felony), and other charges. The court ruled that the sheriff's deputy did not have sufficient probable cause to request a blood draw, so that evidence became inadmissible. The driver then pled guilty to vehicular assault due to reckless driving (Class 5 felony), and sentenced to probation.

Recommendation: Mandatory admissible drug testing of all drivers in crashes resulting in death or serious bodily injury. Enhanced penalties for polydrug impairment. Tandem per se.

Tanya and Adrian Guevarra

Tanya Guevarra, 25, and her 5 week old son Adrian were driving to pick up a prescription in their home town of Dacono, Colorado. Steven Ryan hit them head-on, killing Tanya instantly, but Adrian suffered several days before dying. As is common after a fatal collision, four hours elapsed before a blood sample was taken from Ryan. The blood was tested and confirmed at 4 ng/ml THC.

Fortunately, this crash occurred before Colorado passed its 5 ng THC permissible limit law in 2013. Ryan admitted to driving under the influence of marijuana and accepted a plea agreement for one count of vehicular homicide due to DUID, saving him from the likelihood of being found guilty of two counts. Ryan's attorney argued during the sentencing hearing that the judge should be lenient, because Ryan wasn't even driving under the influence. After all, he was below the 5 ng THC limit that was then being considered by the legislature. The judge was having none of it, saying he could only enforce the laws that had been passed and signed into law.

Tanya's family and DUID Victim Voices testified very effectively at the sentencing hearing, which convinced the judge to levy a sentence of 10 years for the single count of vehicular homicide due to DUI (Class 3 felony). He was released to community corrections shortly after the 5 ng law was passed.

Recommendations: Replace the 5 ng/ml permissible inference law with a Tandem per se law.

Melissa Gallagher

Melissa was a crossing the street at the intersection of Mulberry and Peterson at night in Fort Collins when she was struck and killed by Ryan Marsini (18) in 2010. In spite of an open bottle of liquor and Marisini's admission of using marijuana earlier under Colorado's medical marijuana law, no DRE was called in and no blood tests were taken. Marsini's passengers said he had been taking antidepressants. Marsini was issued a ticket for failing to wear a seat belt. He was arrested for illegal possession of marijuana in New Jersey a year later.

Recommendations: Provide for additional DREs. Mandatory admissible drug testing in all cases of crashes involving death or serious bodily injury. Enhanced penalties for polydrug impairment.

Sharon Moore

After killing Sharon Moore in Aurora in 2011, Makia Milton, a repeat DUI offender, said to police, "Well, I had some marijuana, but I have a card for it. I was involved in a crash, so what? I'm alive, so I'm lucky." Milton's blood, drawn two hours after the crash, had 11 ng/ml THC and the DRE at the scene determined that she was sufficiently impaired by marijuana that she could not drive safely. Nevertheless, Milton was convicted in Adams County of reckless vehicular homicide (Class 4 felony) but acquitted of DUI, vehicular homicide DUI (Class 5 felony), and vehicular assault DUI.

Recommendations: Mandatory admissible drug testing in all cases of crashes involving death or serious bodily injury or death. A Tandem per se law would have ensured a conviction of the higher charge.

John Hines

Joshua Wittig admitted to self-medicating with marijuana, Xanax (a benzodiazepine), Valium (a benzodiazepine) and Percocet (an opioid) at the time of the crash that killed Hines in 2011. He was convicted of vehicular homicide DUI.

Recommendations: Enhanced penalties for polydrug impairment.

Peter Deutz

Deutz was on his motorcycle when he struck John Spence, doing a U turn from the right lane on Federal Blvd. Spence was convicted of reckless vehicular homicide (Class 4 felony) and sentenced to four years in 2011. His blood had 6 ng/ml THC and 108 ng/ml carboxy-THC, indicating daily use, according to the toxicologist. The judge excluded testimony about prior drug use.

Recommendations: A Tandem per se law would have increased the likelihood of a conviction of the higher charge.

Maria Herrera-Octavio

Breana L Garcia's blood test showed a BAC of 0.19 and a positive cannabinoid screen after injuring Maria in 2012. Breana was convicted of reckless vehicular assault in Adams County, acquitted of DUI vehicular assault and sentenced to three years of probation..

Recommendations: Mandatory admissible drug test of all drivers in crashes that result in serious bodily injury. Enhanced penalties for polydrug impairment. Tandem per se.

William Aplin

Justin Hodson injured William in 2012. Hodson's blood was drawn 2 hours after the crash and tested at 4 ng/ml THC. DUI charges were dismissed and Hodson pled guilty to reckless vehicular assault (Class 5 felony), driving without a license, and T1 careless injury and 2 years of probation.

Recommendations: Replace the 5 ng/ml permissible inference law with Tandem per se. Quicker biological sampling with oral fluids. Change careless injury to a Class 6 felony.

Sean Marino

Sean injured 25 people in a multiple car crash which he initiated in 2012. His blood was drawn 3 hours after the crash with 9 ng/ml THC plus morphine, oxycontin, Percoset and Valium. DUI charges were dropped. He pled guilty to reckless vehicular assault and received 5 years of probation.

Recommendations: Quicker biological sampling with oral fluids. Enhanced penalties for polydrug impairment.

Verna Volker

Aaron Coapland injured Verna in Boulder in 2012. Blood was drawn 2½ hours after the crash with a 0.044 BAC and 3 ng/ml THC. DUI charges were dropped. Coapland pled guilty to reckless vehicular assault and received probation.

Recommendations: Replace the 5 ng/ml permissible inference law with Tandem per se. Quicker biological sampling with oral fluids. Enhanced penalties for polydrug impairment. Eliminate the statutory presumption of innocence for a BAC under .05 if other impairing drugs are also present.

Cassandra Bustillos

Conner Magill's blood was drawn in Boulder more than two hours after the crash that injured Cassandra in 2012. The blood had 8 ng/ml THC and over 100 ng/ml carboxy-THC. The DUI charge was dropped. Magill pled guilty to reckless vehicular assault and received probation.

Recommendations: Replace the 5 ng/ml permissible inference law with Tandem per se. Quicker biological sampling with oral fluids.

James Laurel
Burkie Espinoza's blood was drawn in Conejos County 110 minutes after the crash that injured James in 2012. The blood was positive for methamphetamine and 28 ng/ml carboxy-THC. The DUI charge was dropped. Espinoza pled guilty to reckless vehicular assault and received a sentence of four years in community corrections.

Recommendations: Tandem per se. Quicker biological sampling with oral fluids. Enhanced penalties for polydrug impairment.

Tyler Morris
Tyler injured Douglas Snyder, Christine Brewer and Marcie Chase in Jefferson County in 2012. Morris's blood was drawn for testing at 3½ after the crash. The blood tested positive for Clonazepam (a benzodiazepine), Zoloft (antidepressant) and Trazodone (antidepressant). The DUI charge was dropped. He pled guilty to reckless vehicular assault and was sentenced to three years in community corrections, enrollment in a drug offender program and was required to wear a SCRAM (transdermal alcohol monitoring system).

Recommendations: Quicker biological sampling with oral fluids. Tandem per se. Enhanced penalties for polydrug impairment. Eliminate the requirement for alcohol monitoring devices in cases where no alcohol was present.

Robert Gratz
Mark Hendrixson's blood was drawn in Routt County 3 hours 20 minutes after the crash that killed Robert in 2012. The blood had 8 ng/ml THC, 88 ng/ml carboxy-THC and had a BAC of 0.046. DUI charges were dropped. Hendrixson pled guilty to a T1 traffic offense of careless driving resulting in death and was sentenced to one year in jail.

Recommendations: Quicker biological sampling with oral fluids. Tandem per se. Enhanced penalties for polydrug impairment. Eliminate the statutory presumption of innocence for a BAC under .05 if other impairing drugs are also present. Change T1 "Careless driving resulting in death" traffic offense to a Class 5 felony.

Travis Timm
Zachary LeMasters' blood was drawn in Saguache County 3 hours 20 minutes after the crash that killed Travis in 2012. The blood was only tested for alcohol and showed a BAC of 0.143. LeMasters admitted to smoking a bowl of marijuana and taking a hit of LSD before driving. The DUI charge was dropped. LeMasters pled guilty to reckless vehicular homicide in exchange for a jail sentence of six months.

Recommendations: Quicker biological sampling with oral fluids. Mandatory blood tests upon arrest for DUI. Tandem per se. Enhanced penalties for polydrug impairment. Mandatory admissible drug test of all drivers in crashes that result in death.

Sandra Rivas
Unises Nuñez refused a to take SFST test or a chemical test for drugs after killing Sandra in Otero County. He admitted to smoking marijuana before the crash and the arresting officer noted signs of marijuana impairment. His DUI charge was dropped in exchange for a guilty plea to criminally negligent homicide (Class 5 felony) and a two year prison sentence.

Recommendations: Enable biological testing with oral fluids. Mandatory admissible drug test of all drivers in crashes that result in death. Mandatory drug tests upon arrest for DUI. Administrative License Revocation in cases of refusal to take a drug test. Mandatory admissible drug testing in all cases of crashes involving death or serious bodily injury

James Rollison
Ruth Ryan refused to take SFST test or a chemical test for drugs after injuring James in Arapahoe County in 2013. Nevertheless, she was found guilty of DUI and of reckless vehicular assault and sentenced to two years of probation. Her urine sample was positive for Tramadol (an opioid), Xanax (a benzodiazepine), and oxycodone (an opioid) in a pretrial test.

Recommendations: Enable biological testing with oral fluids. Mandatory admissible drug test of all drivers in crashes that result in serious bodily injuries. Administrative License Revocation in cases of refusal to take a drug test. Mandatory drug test upon arrest for DUI. Enhanced penalties for polydrug impairment.

Diondra J Gallegos
James Banker, Lonnie Fransua and Breann Perez were all injured in Jefferson County in 2013 by Diodra who, when "Orange Elephant" Sativa was found in her car, admitted to sharing a bowl with her passengers before driving. She pointed out to the officer, "That's not a drug, it's legit now." She was found guilty of DUI and reckless vehicular assault and sentenced to four years of probation.

Recommendations: Enable biological testing with oral fluids. Mandatory admissible drug test of all drivers in crashes that result in serious bodily injuries. Tandem per se.

Joan R Graber
Joan injured 5 victims in Jefferson County in 2013. Her blood was drawn at 4½ hours after the crash. Joan admitted to using Valium, Diazepam and Morphine. The DUI charge was dropped in exchange for a guilty plea of a T1 traffic offense, careless driving resulting in injury and one year probation.

Recommendations: Enable biological testing with oral fluids. Mandatory admissible drug test of all drivers in crashes that result in serious bodily injuries. Tandem per se. Enhanced penalties for polydrug impairment. Change careless assault to a Class 6 felony.

Nicholette Mizak

Jack Johnson's blood was drawn 3 hours after the crash that injured Nicholette in Douglas County in 2013. The blood test was positive for THC and cocaine. Johnson was found guilty of DWAI and reckless vehicular homicide. He was sentenced to two years of probation.

Recommendations: Enable biological testing with oral fluids. Mandatory admissible drug test of all drivers in crashes that result in serious bodily injuries. Tandem per se. Enhanced penalties for polydrug impairment. Make vehicular assault due to DWAI a Class 4 felony, as it is already for vehicular assault due to DUI.

Michael Wheelhouse

Clarine M Leyba admitted to using methamphetamine and marijuana before injuring Michael in Jefferson County in 2013. She was found not guilty of DUI but guilty of reckless vehicular assault and was sentenced to two years of probation.

Recommendations: Enable biological testing with oral fluids. Mandatory admissible drug test of all drivers in crashes that result in serious bodily injuries. Tandem per se. Enhanced penalties for polydrug impairment.

Peyton Knowlton

Kyle Couch's blood was drawn 2 hours after the crash that killed Peyton. Officers at the scene found signs of impairment and cited Couch for DUI vehicular homicide. The blood test revealed 1.5 ng/ml THC and an alcohol level below Colorado's legal limit.

The Class 3 felony charge was dropped when Couch pled guilty to careless driving resulting in death (a T1 traffic offense) which resulted in a 60-day jail sentence. He also pled guilty to using a false identity for purchase of alcohol and marijuana, resulting in an additional sequential 90-day sentence. That makes a total of 150 days in jail for killing an 8-year old girl who just celebrated her 2nd grade graduation.

Recommendations: Enable biological testing with oral fluids. Mandatory admissible drug test of all drivers in crashes that result in death. Tandem per se. Enhanced penalties for polydrug impairment. Eliminate the statutory presumption of innocence for a BAC under .05 if other impairing drugs are also present. Change T1 traffic offense "Careless driving resulting in death" to a Class 5 felony.

Chapter 11
Colorado Recommendations

Several organizations have proposed model policies for consideration. These are described in Chapter 7. The broadest were those proposed by the Governors Highway Safety Association (GHSA) and the European Traffic Safety Council (ETSC), which included both proposed policies and proposed laws.

To the policies proposed by GHSA for Education, Training, and Prosecution and Adjudication we would add consideration of a mechanism to keep skills honed for ARIDE-trained officers. There are already requirements for officers to maintain their SFST skills through periodic training, and very stringent requirements to ensure DRE officers regularly demonstrate their proficiency. In contrast, after ARIDE training is provided to an officer, there are no required refresher courses or other provisions to ensure ARIDE skills remain sharp.

To the Research policies proposed by ETSC, we would add consideration of current strains and strengths of marijuana preparations commercially used, as well as new and increasingly popular modes of administration such as vaping and edibles.

But we will focus our attention in this chapter to three sections in the GHSA 2017 recommendations:

Laws and Sanctions – 8 proposals
Testing – 4 proposals
Data – 1 proposal

For each of these three sections we will propose legislative actions that ought to be considered by Colorado, in light of current data and past experiences of DUID victims.

Laws and Sanctions

1. Redefine DUI for drugs

   Table 14 in Chapter Six described the wide variation in DUI definitions. Although it may be easier to convict under a “affects the person to the slightest degree” definition than under an “incapable of safe driving” definition, this is rarely an issue for alcohol impairment. Alcohol *per se* laws make the definitions somewhat moot for alcohol.

That is not the case for drugs where no scientifically recognized non-zero *per se* limits have been or can be established. Lacking scientifically valid impairment-based *per se* limits, zero-tolerance laws or a Tandem *per se* law, prosecutors must prove impairment in order to convict. In those cases, the definition of impairment or "under the influence" is extremely significant.

Recognizing this dilemma, Vermont recently amended their DUI statute to define DUID different from DUI-alcohol (23 VSA 1201):

> As used in subdivision (a)(3) of this section, "under the influence of a drug" means that a person's ability to operate a motor vehicle safely is diminished or impaired in the slightest degree. This subsection shall not be construed to affect the meaning of the term "under the influence of alcohol."

Prosecutors in Colorado can work with two different definitions, one for DUI, the other for DWAI:

> (f) "Driving under the influence" [DUI] means driving a motor vehicle or vehicle when a person has consumed alcohol or one or more drugs, or a combination of alcohol and one or more drugs, that affects the person to a degree that the person is substantially incapable, either mentally or physically, or both mentally and physically, to exercise clear judgment, sufficient physical control, or due care in the safe operation of a vehicle.
> (g) "Driving while ability impaired" [DWAI] means driving a motor vehicle or vehicle when a person has consumed alcohol or one or more drugs, or a combination of both alcohol and one or more drugs, that affects the person to the slightest degree so that the person is less able than the person ordinarily would have been, either mentally or physically, or both mentally and physically, to exercise clear judgment, sufficient physical control, or due care in the safe operation of a vehicle.

In drug cases, prosecutors may seek DWAI convictions rather than DUI convictions because of these differences. DWAI Sanctions for DWAI spelled out in C.R.S. 43-4-1307 are somewhat more modest than sanctions for DUI, but they are far stronger than the lack of sanctions that would occur in the case of no conviction.

Legislators should consider changing the definition of DUI for drugs to mirror the current DWAI definition as Vermont has done to more readily enable DUID convictions.

Alternatively, legislators may be satisfied with a DWAI conviction for drug-impaired drivers, and simply accept the lower sanctions compared with DUI.

If the latter approach is taken, one further problem must be addressed. Although DUI vehicular homicide is a Class 3 felony, DWAI vehicular homicide is not even a misdemeanor. Although DUI vehicular assault is a Class 4 felony, DWAI vehicular assault is not even a misdemeanor. This problem can be readily fixed by reclassifying certain felonies and misdemeanors as suggested in #4 below.

2. Replace the 5 ng/ml permissible inference law with a Tandem *per se* law

   It is evident that Colorado's 5 ng/ml permissible inference law must be changed for all the reasons described in Chapter 3. Alternative replacements are listed in the order of desirability:

   a. Tandem *per se*
      A driver is guilty of DUID *per se* if the following sequence of events occurs:
      a) An officer had probable cause, based on the driver's demeanor, behavior and observable impairment to believe that the driver was impaired; <u>and</u>
      b) Proof that the driver had any amount of an impairing substance in their blood, oral fluid or breath.

      This is consistent with recommendations from leading scientists[106] as well as legislation in Norway and Belgium. See Chapter 12 for a more complete discussion of Tandem *per se.*

   b. Zero tolerance
      Sixteen states have zero drug tolerance laws for drivers, following the Department of Transportation drug tolerance policy for commercial drivers and other select employees. These zero tolerance laws vary widely from state-to-state but all are suitable substitutes for Tandem *per se*. Zero tolerance laws are very difficult to pass because of three common objections:
      - The term "zero tolerance" is considered to be intolerant – because it is.
      - The public believes the levels should be like alcohol in that they prove impairment, whereas they are actually chosen politically without proof of impairment.
      - Some of the public objects to a law that punishes the mere presence of a drug without regard to whether or not the individual was impaired. This objections persists, in spite of the fact that in zero-tolerance states, officers must have probable cause to believe the driver was impaired before collecting a blood sample for testing.

      Tandem *per se* was created to overcome the above objections to zero tolerance.

   c. Revert to an impairment based law with a revised definition of impairment discussed in #1, combined with a zero tolerance for impairing drugs in drivers under the age of 21 (see #3 below). This is not a preferred option, but could be an acceptable temporary option until the political will enables adoption of either Tandem *per se* or zero tolerance.

   d. Non-zero *per se* limits for drugs

This cannot be realistically done for all the impairing drugs currently in use. Nevertheless, this approach has been taken, albeit poorly, by Virginia, Ohio and Nevada. It has been taken more logically by Norway (20 drugs) and England and Wales (16 drugs). Yet they were unable to establish appropriate levels for opioids that create such high tolerance/addiction rates that they defy establishing reasonable limits. This is less of a problem for them since they do not have the opioid addiction rates that we have in this country. Non-zero *per se* limits do not deal well with polydrug impairment which is more common than impairment by any single drug. These laws are also currently limited to blood testing that is likely to be joined by and perhaps replaced by oral fluid testing in some circumstances.

e. The Canadian approach
Canada is currently considering bill C-46 that would establish zero tolerance for 8 impairing illegal drugs and a two-tier approach for marijuana's THC. A blood THC level ≧2 ng/ml would be a minor offense resulting in a fine, whereas a blood THC level ≧5 ng/ml would be a hybrid offense that could be prosecuted as a criminal offense. This has the following drawbacks:
  - It does not address impairment by legal drugs.
  - The THC two-tier system is confusing, contentious and will likely not survive a constitutional challenge.
  - The 5 ng/ml limit has all the drawbacks previously discussed and summarized below.

f. 5 ng/ml *per se* for THC
This is only very slightly better than a 5 ng/ml THC permissible inference law. It has the following drawbacks:
  - 5 ng/ml is not a scientifically valid limit for impairment.
  - The majority of marijuana-impaired drivers test below that limit.
  - All drivers impaired by marijuana edibles test below that limit.
  - This does not address or recognize that there are other causes of DUID.
  - This does not deal with polydrug impairment.

3. Zero tolerance for minors
Modify the current CRS 42-4-1301 zero tolerance for alcohol in minor drivers to include zero tolerance for impairing drugs. Add the underlined portion to the current statute. This may not be necessary if the state adopts either a Tandem *per se* or a zero tolerance law.

It is a class A traffic infraction for any person under twenty-one years of age to drive a motor vehicle or vehicle when the person's BAC, as shown by analysis of the person's breath, is at least 0.02 but not more than 0.05 at the time of driving or within two hours after driving. <u>It is a class A traffic infraction for any person under twenty-one years of age to drive a motor vehicle or vehicle when the person has any detectable level of impairing drugs in their blood, breath or oral fluid at the time of driving or within two hours after driving.</u>

Washington has an Administrative License Revocation for minors with any level of THC in their blood. Minors driving after consuming marijuana or any controlled substance in South Dakota commit a misdemeanor.

4. Reclassify certain felonies and misdemeanors
Replace Careless driving resulting in death with Vehicular homicide due to careless driving.
Replace Careless driving resulting in injury with Vehicular assault due to careless driving.

Table 15 – Recommended felony and misdemeanor reclassifications

Law	Provision	Class	Sentence range	Recommend
18-3-106	VH – DUI	Class 3 felony	4-12 years	Keep
18-3-106	VH – reckless	Class 4 felony	2-6 years	Keep
18-3-106	VH – careless	Class 5 felony	1-3 years	New
42-4-1402	Careless death	T1 Traffic Offense	<1 year	Repeal
42-4-1402	Careless assault	T1 Traffic offense	<1 year	Repeal
18-3-205	VA – careless	Class 6 felony	1 – 1½ year	New

Assuming Colorado retains its two-tier DUI/DWAI definitions, change 18-3-106 Vehicular Homicide and 18-3-205 Vehicular Assault to include DWAI:

Table 16 – Recommended felony reclassifications assuming DWAI and DUI remain

Law	Provision	Class	Recommend
18-3-106	VH-DUI	Class 3 felony	Keep
18-3-106	VH-DWAI	Class 3 felony	New
18-3-205	VA-DUI	Class 4 felony	Keep
18-3-205	VA-DWAI	Class 4 felony	New

5. Screening test parity – alcohol and drugs
   a. 42-4-1301 provides that an officer may conduct a preliminary screening test for alcohol if the officer has a reasonable suspicion that the driver was under the influence of alcohol. Amend this to permit a preliminary screening test for drugs if the officer has a reasonable suspicion that the driver was under the influence of drugs.
   b. 42-2-126 permits the DMV to revoke a driver's license if a driver either refuses chemical testing or if the chemical test shows a BAC in excess of .08 per 42-2-126. Amend this to permit a revocation if a driver tests positive for drugs or refuses to be tested for drugs.

6. Eliminate statutory presumption of innocence for BAC <.05
42-4-1301 (6)(a)(I) provides a statutory presumption of not guilty of DUI alcohol if the blood test is below .05 gm/dl alcohol. This should be amended to be limited to cases where alcohol is the only impairing drug confirmed.

7. Enhance penalties for polydrug impairment
   In cases where a person has been convicted of DUI or DWAI due to two or more drugs, including alcohol, the sentence defined in 42-4-1307 should be amended to be the same as a driver who tested above 0.2 gm/dl alcohol, plus double the amount of fine and double the amount of useful public service.

8. Drug-specific prevention sanctions
   a. Eliminate the use of ignition interlocks in cases of DUI or DWAI when there is no evidence of alcohol use.
   b. Eliminate the use of transdermal alcohol sensing devices in cases of DUI or DWAI when there is no evidence of alcohol use.

<u>Testing</u>

1. Mandatory evidentiary drug testing
   - Evidentiary drug testing shall be performed on the blood or oral fluid of any driver who tests positive for drugs on a preliminary roadside screening test.
   - Evidentiary drug testing shall be performed on the blood or oral fluid of all drivers involved in any crash which results in either death, serious bodily injury, or both.

   See Chapter 12 for a more complete discussion of mandatory drug testing.

2. Implement oral fluid testing
   - Roadside non-quantitative preliminary oral fluid testing devices may be used by officers if the officer has reasonable grounds to believe that the driver may be impaired by drugs. This shall parallel the similar provisions for preliminary breath testing.
     - Results of non-quantitative oral fluid testing shall guide officers in evidence collection.
     - Roadside non-quantitative oral fluid testing results shall not be admissible in trial.
   - Evidentiary laboratory oral fluid testing may be used in lieu of blood evidentiary testing to prove the presence of an impairing substance.

   See Chapter 12 for a more complete discussion of oral fluid testing.

3. Electronic warrants to reduce blood collection delays
   Electronic warrants are in use in Larimer County to shorten the time required to obtain a warrant used to compel a blood draw. Encourage use of this technology in all jurisdictions who have a need for it.[107]

4. Testing to be performed per National Safety Council recommendations.[108]
   The National Safety Council's Alcohol, Drugs and Impairment Division published a 2017 update to their recommended Tier I (mandatory) and Tier II (optional) drugs to be tested for in DUI and fatal crash cases, with recommended laboratory sensitivity levels for blood, oral

fluid and urine. These recommendations should be followed as a minimum by laboratories providing services to law enforcement agencies in Colorado.

Data

1. Incorporate evidence collected at the scene of an arrest in DCJ report
GHSA recommends that states "Track DUID and DUI separately in crash, arrest, licensing, and court data to the extent possible." NHTSA further recommends "States should develop record systems that distinguish among alcohol, drugs, or both for impaired driving cases. These records should be integrated into computerized data systems of statewide arrest records, the court record systems, and motor vehicle records. One way to accomplish this would be to have separate offenses for driving impaired by alcohol and driving impaired by drugs. "

   DCJ's report pursuant to HB17-1315 is a model to build upon and may become recognized as the premier such report in the nation. It is destined to improve as further drug testing is performed and recorded, and data systems can better link between relevant agencies.

   But there is a glaring absence of impairment data in the DCJ report. The DCJ report relies on toxicology data. Toxicology proves what drugs were present, but does not prove impairment. None of the evidence collected at the scene of an arrest that proves impairment by alcohol, drugs or both is included in the DCJ report. NHTSA's suggestion that the state incorporate separate offenses for driving impaired by alcohol and driving impaired by drugs would be a great start to obtaining this data for analysis, but Colorado prosecutors do not favor this solution.

   There should be a mechanism created to incorporate relevant evidence to support charges of impairment in the DCJ report.

Chapter 12
Rationale for proposed transformative changes

The recommendations in Chapter 11 fall into two categories:

1. Transformative changes
   - Amend 5 ng/ml permissible inference law
   - Mandatory drug testing in select cases
   - Implement oral fluid testing
2. Improvements
   - Everything else

Following are the reasons to support the proposed transformative changes.

Change 5 ng/ml permissible inference to Tandem *per se*

It is quite clear from the evidence presented in Chapter 3 and the DCJ report that the 5 ng/ml permissible inference law in Colorado is a mistake and it must be replaced with a better answer to our DUID problem. In Chapter 11, we list 6 alternatives to a 5 ng/ml permissible inference law, only two of which are recommended, and a third is described as an acceptable temporary option.

Most of the alternatives are quite familiar, but the leading alternative, Tandem *per se* is a newly coined term for a familiar concept, so a few words of explanation are in order. The concept was described in the American Automobile Association press release of May 10, 2010:[109]

> AAA is urging states to use more comprehensive enforcement measures to improve road safety. Rather than relying on arbitrary legal limits, states should use a two-component system that requires (1) a positive test for recent marijuana use, and most importantly, (2) behavioral and physiological evidence of driver impairment. This system would rely heavily on two current law-enforcement training programs: Advanced Roadside Impaired Driving Enforcement (ARIDE) and the 50-state Drug Evaluation and Classification (DEC) program. These programs train law enforcement officers around the country to more effectively recognize drug-impaired driving.

The press release extract above summarized a more lengthy description below, also focusing only on marijuana, in the publication by the AAA Foundation for Traffic Safety:[110]

> In the absence of a scientifically based cannabis per se law, there are several options. One is to train officers to detect the signs and symptoms of cannabis use in drivers stopped at roadside. Initial suspicion of cannabis use would lead to a field sobriety test (SFST). This

> process could be coupled with rapid, on-site oral fluid screening for evidence of drug use. The technology to detect certain drugs (including cannabis) in a specimen of oral fluid quickly at roadside is improving and could be used in a manner comparable to preliminary breath testing devices currently used to test for alcohol. The suspect would then be taken for a complete drug evaluation by a DRE. This approach requires enhancing the complement of DRE officers available to conduct assessments for impairment.
>
> The DEC approach, however, does have limitations, including the availability of DRE certified officers to attend and evaluate subjects in a timely manner. The IACP 2014 DRE Section report indicates that in 2014, there were 26,471 enforcement evaluations performed in the United States by 5,098 DRE officers representing 2,176 police agencies or locations [29]. Agency policy of when DREs respond, interagency collaborations in providing DRE officers to cover each other's' cases, and DRE availability late at night when many of these arrests are made, all may limit the availability of a DRE to respond. In addition, the DEC program requires recertification every two years, and not all officers recertify.

The most succinct version of the recommendation was published in the Santa Fe New Mexican when that state considered and then rejected adoption of a 5 ng/ml THC *per se* limit:[111]

> We believe that a much better alternative to choosing an arbitrary drug *per se* level above zero is the Tandem *per se* approach, which requires a sequence of events to prove the crime of driving under the influence of drugs *per se*. Using this approach, a person would be guilty of driving under the influence of drugs *per se* if:
>
> - An officer had probable cause, based on the driver's demeanor, behavior and observable impairment to believe the driver was impaired; and
> - The driver had any amount of an impairing substance in his/her blood, oral fluid or breath.

The Tandem *per se* approach is similar to the zero-tolerance approach used by the 16 states which also require probable cause to test blood for drugs, except Tandem *per se* requires the probable cause to be based on driver symptoms. Tandem *per se* was devised to overcome the following common objections to zero-tolerance laws:

- The term "zero tolerance" is considered to be intolerant – because it is.
- The public believes the levels should be like alcohol in that they prove impairment, whereas they are actually chosen politically without proof of impairment
- Some of the public objects to a law that punishes the mere presence of a drug without regard to whether or not the individual was impaired. This objections persists, in spite of the fact that in zero-tolerance states, officers must have probable cause to believe the driver was impaired before collecting a blood sample for testing.

Mandatory drug testing in select cases

The need for this may be less clear than the need for replacing the 5 ng/ml permissible inference law.

Mandatory evidentiary drug testing is proposed in two situations:

- When a driver tests positive for drugs in a preliminary drug test; and

- For all drivers involved in crashes resulting in death or serious injury.

If preliminary roadside oral fluid drug tests are implemented as described below, requiring an evidentiary test in case of a positive reading is a natural logical extension. If a preliminary roadside drug test is negative for drugs, an evidentiary test may not be required unless there is evidence of impairment by drugs not included in the preliminary screen, since roadside drug screening devices cannot test for all classes of drugs.

The State of Washington has been testing all blood samples of DUI suspects for both alcohol and drugs since 2013. About 30% of DUI suspects are blood tested, the remaining are breath tested only. Orange County, California began the same policy of testing all blood samples for drugs in 2017.

There are two reasons to require mandatory drug tests in cases of crashes and serious injuries:

1. To provide justice to victims. Victim stories in Chapter 10 repeatedly show the anguish caused to victims and their families when evidence to convict a driver of drugged driving was not collected, pursued, or admitted into evidence. All too often either drug tests were not performed, or if performed, they were not admissible due to lack of adequately documented probable cause to require the chemical test.

2. The vast majority of crashes resulting in either vehicular homicide or vehicular assault charges are due to impaired drivers. In a Colorado study of 2013 vehicular homicide and vehicular assault cases, 78.4% were also charged with DUI.[112] Half of the remaining drivers were charged with hit and run, frequently the result of someone trying to avoid a DUI charge.

   Since the overwhelming proportion of vehicular homicide and vehicular assault cases are caused by impaired driving, mandatory chemical testing of drivers would pose little inconvenience and would have the following advantages:
   - Shorten time between a crash and collecting a biological sample since time to establish and document grounds to request a sample would not be needed; and
   - Reduce ambiguity about the admissibility of laboratory tests in court cases.

Implement oral fluid testing

Although Australia published its standard for oral fluid testing for roadside DUI testing in 2005 (AS4760)[113], oral fluid testing is still an emerging technology in the United States. It is being used on an evaluation basis in numerous locations around the US but so far its use has been statutorily mandated only in five counties in Michigan as a pilot program.

As a relatively new technology, the scientific literature is fairly recent and because terminology can be inconsistent, care must be exercised when interpreting published conclusions. Some refer to this technology as saliva testing or oral swab testing.

Although the terms are frequently used interchangeably, they are not identical. Saliva is the ultrafiltrate of plasma produced by the salivary glands. Oral fluid is predominantly saliva but also contains contaminants in the mouth left from eating, drinking, smoking and breathing. An oral swab is a common device used to obtain oral fluid for testing. All oral fluid tests do not rely upon swabs. The swab is not tested; the oral fluid obtained by the swab is tested.

The Police Chief issued a succinct recommendation on the use of oral fluids last year in an article co-authored by a DRE, a prosecutor and a toxicologist,[114] all highly respected in their fields of expertise:

> "On-site oral fluid testing devices are not perfect; however, they provide a viable and cost-effective way to identify drugged drivers proximate to the traffic stop. The authors recommend that officers screen all impaired drivers for drugs using on-site devices. It is also recommended that jurisdictions consider replacing blood and urine testing with oral fluid laboratory tests for four reasons.
>
> First, as noted above, McNeely and Birchfield make it difficult for officers to obtain blood (and possibly urine) samples without a warrant. However, those same cases suggest that oral fluid testing doesn't carry those legal challenges.
>
> Second, officers can collect evidentiary samples for submission to the laboratory at roadside, which minimizes the possibility that the DUI subjects will eliminate the drugs from their system.
>
> Third, positive oral fluid test results of a parent drug indicate recent usage only, potentially correlating to the duration of drug effect, and do not indicate use from days ago.
>
> Fourth, it appears that states may criminalize oral fluid test refusals, unlike blood tests, thus increasing test compliance rates."

This recommendation makes a clear distinction between two types of oral fluid testing:

1. Preliminary non-quantitative tests done at the roadside
   These use commercially available devices from companies such as Abbott/Alere, Dräger, and SecureTec/DrugWipe. The devices screen for typically 6-8 classes of drugs and provide a positive/negative screening result in 10 minutes or less. The top devices test for most common drugs: THC (they can discriminate between THC and inactive carboxy-THC), opioids, cocaine, methamphetamine, and benzodiazepines.

2. Evidentiary tests
   Oral fluid can be collected with a number of commercially available sampling devices. The oral fluid is then transferred to a forensic toxicology laboratory that can test for drug presence and concentration, just as if it were a blood sample.

Preliminary drug tests can perform the same function for drug assessment that PBTs (Preliminary Breath Tests) do for alcohol assessments. They can guide the officer in collecting appropriate evidence for a trial. The results may not admissible at trial. However one court in California has permitted the results from a Dräger device to be admitted into evidence.[115]

It is important to understand that oral fluid devices neither attempt to nor claim to do any of the following:

1. Test for all drugs

    See below for a summary of drugs detected with leading commercial devices.

2. Prove impairment

    PBTs also don't prove alcohol impairment. Evidentiary blood tests don't prove impairment either, but they can prove violation of a DUI *per se* statute. Impairment is proven by evidence collected at the scene of an incident. Chemical tests, whether they be roadside or evidentiary laboratory tests either indicate or prove the chemical cause of the impairment that is otherwise observed and documented by police at the scene of an incident.

3. Correspond to blood test results

    Drug levels are different in different body fluids and tissues. The difference in concentration of a drug between blood and oral fluids varies by drug. For example, THC levels are higher in oral fluid than in the brain, higher in the brain than in blood, and higher in blood than in urine. One cannot expect an oral fluid result to correspond to a blood test, just as a blood test does not correspond to what really matters, which is the level in the brain.

There are dozens of commercially available devices designed for roadside testing, all using similar well-established immunoassay technology, but with different design features, specifications and limitations. Table 17[116] shows the drugs tested by many of these devices.

Table 17 Drugs Tested by Roadside OF Devices

Device	Drugs Screened
Dräger	Amp, mAmp, Coc, Opi, THC, Benzos, MDN
Oratect	Amp, mAmp, Coc, Opi, THC, PCP
OraScreen	Amp, mAmp, Coc, Opi, THC
DrugWipe	Amp/mAmp, Coc, Opi, THC, Benzos
iScreen	Amp, mAmp, Coc, Opi, THC, PCP
OraLine	mAmp, Coc, Opi, THC
Oral Q	mAmp, Coc, Opi, THC, Oxy, Benzos
Oral Stat	Amp, mAmp/MDMA, Coc, Opi, THC, Benzos, MDN, PCP, Barbs, PPX
ToxSure	Amp, mAmp, Coc, Opi, THC, Benzos
Alere	Amp, mAmp, Coc, Opi, THC, Benzos
Saliva Scan	Amp, mAmp, Coc, Opi, THC, Benzos, MDN, Bup
Xalex	Amp, mAmp, Coc, Opi, THC, PCP

Logan. IATFDD. 2014

All devices check for the major drugs of interest in Colorado, THC, methamphetamine, opioids, benzodiazepines and cocaine. Some also check for phencyclidine, methadone, barbiturates and other drugs as well.

THC tests are specific for delta 9-THC with limited cross-reactivity to carboxy-THC.

Most scientific testing of roadside devices in the US, Canada, Australia and Europe has been done on three of the above devices that have been rated the highest for sensitivity, performance and robustness. These three are shown in Table 18 with the manufacturers' stated "cutoff" value.

Table 18 Comparison of sensitivities

Analyte	DDT 5000 Cut-offs (ng/mL)	DrugWipe Cut-offs (ng/mL)	Alere DDS2 Cut-offs (ng/mL)	NMS Labs Screen (ng/mL)
Amphetamine	50 (Amp)	60 (Amp)*	50 (Amp)	20 (Amp)
Methamphetamine	35 (mAmp)	60 (mAmp)*	50 (mAmp)	20 (Meth)
Benzodiazepines	15 (Diaz)	10 (Diaz)	20 (Temaz)	5 (Diaz)
Opiates	20 (Morphine)	10 (Morphine)	40 (Morphine)	20 (Morphine)
Cocaine	20 (Coc)	10 (Coc)	10 (BE)	20 (Cocaine)
Cannabinoids	5 (THC)	20 (THC)	25 (THC)	4 (THC)
Methadone	20 (Methadone)	-	15 (Methadone)	50 (Methadone)

Logan. IATFDD. 2014

The common term "cut-off" has been widely misinterpreted. For example, the Dräger DT 5000 reports a "cut-off" of 5 ng/ml THC. First of all, this does not equate to 5 ng/ml in whole blood since THC is far more highly concentrated in oral fluid than in blood. Secondly, these are all analog devices and do not have a "cut-off' sensitivity in the way we might think of it in a digital world. The devices don't count or measure molecules of the drug being assayed. They measure the brightness of a dye that attaches to the target molecule and then correlate that brightness with a specific drug concentration level. The distinction was clarified by Dr. Kristian Lettau of Dräger at a Kelly-Frye hearing in Kern County, California.[117]

> The immunoassay is manufactured or is set in such a way that the boundary, which is called the cutoff, and at this amount of drug you have basically a probability that 50 percent that the drug is in the sample, but the further away you move from this boundary, the more sure you are that the drug is really there. We manufacture our tests at this plus or minus 50% of this cutoff concentration.

Table 19[118] shows typical ratios between the concentration found in oral fluid versus blood.

Table 19

Oral fluid/blood ratio **(dependent on various factors)**

Substance	n	ratio
Amphetamine	158	16
Cocaine	40	30
Codeine	26	6.8
MDMA	54	3.3
Morphine	17	2.7
Nordiazepam	65	0.02
THC	323	16-20

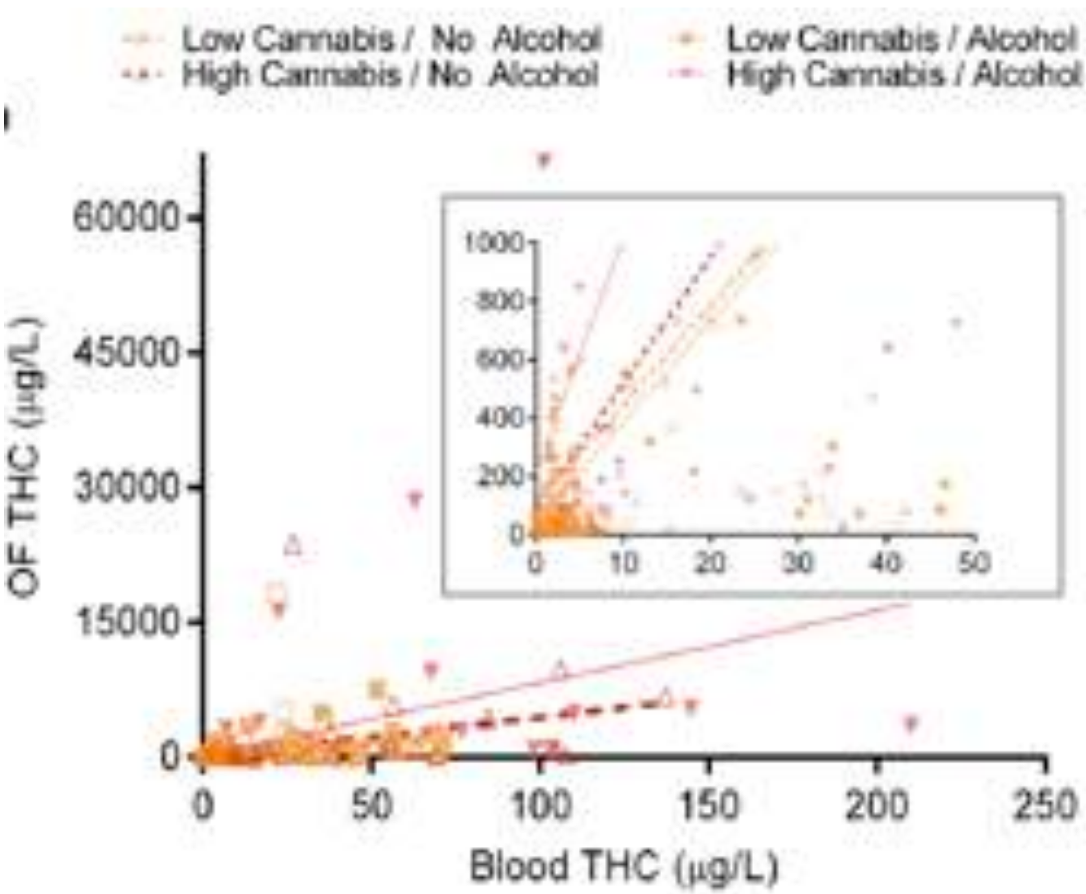
For **THC** 1 ng/mL blood ≈ 16-20 ng/mL oral fluid

So 10 ng/mL oral fluid is actually (on average) < 1 ng/mL

Drummer. Standards Australia Forum. 2013

Other researchers have reported different ratios of THC concentrations in oral fluid compared to whole blood from 9.4[119] to 14[120] to 44[121]. Figure 25[122] graphically shows how variable this can be with vaped marijuana with and without alcohol.

Figure 25



The variability between oral fluid concentrations of a drug and blood concentrations do not indicate that oral fluid testing is inaccurate. It simply reflects normal biological variability. In fact, oral fluid testing devices are remarkable accurate as indicated by Table 20.[123]

Table 20 Performance measures (with 95% CI) of 3 OF screening devices

	Sensitivity	Miss rate	Specificity	False alarm Rate	Positive Predictive Value	Accuracy
THC	0.869	0.131	0.955	0.045	0.922	0.923
N = 323	(0.789–0.918)	(0.079–0.207)	(0.917–0.973)	(0.022–0.086)	(0.853–0.961)	(0.886–0.948)
Cocaine	0.846	0.154	0.993	0.007	0.990	0.926
N = 256	(0.770–0.900)	(0.096–0.235)	(0.960–0.999)	(0.00–0.045)	(0.938–0.999)	(0.884–0.953)
Amphetamine	0.771	0.229	0.964	0.036	0.923	0.895
N = 306	(0.683–0.839)	(0.156–0.322)	(0.928–0.983)	(0.015–0.075)	(0.845–0.966)	(0.854–0.926)
Methamphetamine	0.840	0.160	0.965	0.035	0.965	0.899
N = 306	(0.776–0.889)	(0.109–0.227)	(0.920–0.985)	(0.013–0.084)	(0.915–0.987)	(0.858–0.929)
Opioids	0.899	0.101	0.931	0.069	0.795	0.924
N = 301	(0.805–0.950)	(0.036–0.164)	(0.891–0.957)	(0.043–0.112)	(0.787–0.943)	(0.913–0.968)
Benzodiazepines	0.592	0.408	0.976	0.024	0.918	0.855
N = 241	(0.480–0.696)	(0.298–0.527)	(0.939–0.990)	(0.008–0.065)	(0.795–0.973)	(0.802–0.895)
All Drug Categories	0.874	0.126	0.932	0.068	0.965	0.892
N = 641	(0.838–0.903)	(0.097–0.162)	(0.886–0.961)	(0.039–0.114)	(0.940–0.980)	(0.865–0.915)

Bierness.CSFS Journal. 2016

When evaluating devices like this, scientists are careful to distinguish between the terms sensitivity, specificity, accuracy and positive predictive value, defined in Table 21[124].

Table 21 "Accuracy" terms

Condition	Defined as	Calculated as
Verified positive (VP)	'True Positive'; a positive finding in the field test confirmed positive by the confirmatory test.	–
Verified negative (VN)	'True Negative'; a negative finding in the field test confirmed negative by the confirmatory test.	–
Additional finding (AF)	'False Negative'; a positive finding from the confirmatory test not predicted by the field test.	–
Unconfirmed positive (UP)	'False Positive'; a positive finding from the field test not confirmed by the confirmatory test.	–
Sensitivity	Proportion of subjects who subsequently test positive in a confirmatory test whose positive status was correctly predicted by the field test.	VP/(VP + AF)
Specificity	Proportion of subjects who subsequently test negative in a confirmatory test whose negative status was correctly predicted by the field test.	VN/(VN + UP)
Accuracy	Overall proportion of subjects whose drug status as determined by a subsequent confirmatory test was correctly predicted by the field test.	(VP + VN)/ (VP + VN + AF +
PPV	Proportion of subjects whose field test correctly predicted they would test positive in the confirmatory test.	VP/(VP + UP)
NPV	Proportion of subjects whose field test correctly predicted they would test negative in the confirmatory test.	VN/(VN + AF)

Logan. J Anal Tox. 2014

Rather than accuracy, the terms of greatest interest from a policy standpoint are sensitivity and specificity. Sensitivity tells us how likely the device is to be able to detect the presence of a substance, and specificity tells us how likely that a true negative sample would be determined to be negative by the device.

Table 19 shows *pooled* results for the Dräger, Alere/Abbott and DrugWipe devices, since the objective of the published study that created Table 19 was not to compare devices but rather to determine if the core technology used in the three leading devices was “ready for prime time.” Results show that the devices are not perfect, but are comparable in usefulness to PBT tests. They also are very unlikely to identify a positive drug presence in a driver that would test negative in a confirmatory laboratory test. The devices are most sensitive for THC, opioids and cocaine, and least sensitive for benzodiazepines.

Norway implemented an impairment law on DUID in 1959, requiring documentations of clinical impairment in addition to positive drug test result. They have established *per se* limits on 20 drugs, including 1.3 ng/ml THC in whole blood. Since 2015 they have been using 25 Dräger DT 5000 devices to improve their management of DUID. Gjerde reports[125] that the devices are a valuable tool in identifying impaired drivers, resulting in a more than doubling the number of DUID offenders.

About the author:

Ed Wood founded DUID Victim Voices in honor of his son Brian, killed at age 33 by drug impaired drivers (two at the wheel of the same vehicle). He learned first-hand that laws designed to ensure justice in cases of alcohol-impairment don't work well in many cases of drug-impairment.

Wood has a B.S. in Chemistry from Harvey Mudd College, an MBA from University of Colorado and became the founding CEO of COBE BCT. Wood has worked with victims, prosecutors, defense attorneys, judges, clinicians, drug recognition experts, law enforcement officers, toxicologists, legislators, state officials, and an international list of researchers and other specialists in his quest to increase public knowledge about DUID. He has four peer-reviewed publications and wrote the 2017 law requiring Colorado to begin collecting and reporting data on drug-impaired driving.

DUID Victim Voices provides education and promotion of effective laws to reduce Driving Under the Influence of drugs. Wood seeks to provide a scientifically-based perspective from DUID Victims. See www.duidvictimvoices.org for further information.

DUID Victims who wish to have their voices heard are urged to contact Ed Wood at ed@duidvictimvoices.org.

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Crash Fatality Rates After Recreational Marijuana Legalization in Washington and Colorado

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Objectives. To evaluate motor vehicle crash fatality rates in the first 2 states with recreational marijuana legalization and compare them with motor vehicle crash fatality rates in similar states without recreational marijuana legalization.

Methods. We used the US Fatality Analysis Reporting System to determine the annual numbers of motor vehicle crash fatalities between 2009 and 2015 in Washington, Colorado, and 8 control states. We compared year-over-year changes in motor vehicle crash fatality rates (per billion vehicle miles traveled) before and after recreational marijuana legalization with a difference-in-differences approach that controlled for underlying time trends and state-specific population, economic, and traffic characteristics.

Results. Pre–recreational marijuana legalization annual changes in motor vehicle crash fatality rates for Washington and Colorado were similar to those for the control states. Post–recreational marijuana legalization changes in motor vehicle crash fatality rates for Washington and Colorado also did not significantly differ from those for the control states (adjusted difference-in-differences coefficient = +0.2 fatalities/billion vehicle miles traveled; 95% confidence interval = –0.4, +0.9).

Conclusions. Three years after recreational marijuana legalization, changes in motor vehicle crash fatality rates for Washington and Colorado were not statistically different from those in similar states without recreational marijuana legalization. Future studies over a longer time remain warranted. (*Am J Public Health*. 2017;107:1329–1331. doi: 10.2105/AJPH.2017.303848)

A recent analysis found that medical marijuana legalization has been associated with overall reductions in motor vehicle crash fatalities, although the state-specific effects vary widely.[1] Other studies of marijuana-related motor vehicle crashes before and after medical marijuana legalization have produced conflicting results.[2–5] What remains unknown is whether recreational marijuana legalization affects motor vehicle crash fatality rates. The purpose of this study was to evaluate pre– and post–recreational marijuana legalization changes in motor vehicle crash fatality rates in the first 2 US states to pass recreational marijuana legalization—Washington (November 2012) and Colorado (December 2012)—and to compare them with motor vehicle crash fatality rates in 8 similar states without medical marijuana legalization or recreational marijuana legalization.

METHODS

We selected control states a priori based on their similarity to Washington or Colorado, primarily in terms of traffic and roadway characteristics but also in terms of population, drivers, vehicle ownership, and traffic laws (Appendix A, available as a supplement to the online version of this article at http://www.ajph.org). We then used the National Highway Traffic Safety Administration's Fatality Analysis Reporting System (FARS) to determine the annual number of motor vehicle crash fatalities in Washington, Colorado, and each control state for 2009 through 2015. We obtained annual vehicle miles traveled data for each state from Federal Highway Administration reports and calculated annual motor vehicle crash fatalities per billion vehicle miles traveled.

We used a difference-in-differences approach[6] to compare year-over-year changes in motor vehicle crash fatality rates in Washington and Colorado following recreational marijuana legalization with the contemporaneous crash data for the control states. Common for analyzing policy-level interventions, this difference-in-differences approach allowed us to control for underlying time trends and state-specific population and traffic characteristics.[7] Our analysis included (for each state) year-specific population data; male-to-female population ratio; total annual Federal Highway Administration appropriations as a measure of road construction and maintenance activity; annual gross domestic product, per-capita real income, and unemployment rate as measures of economic conditions; per-capita alcohol consumption; and transportation system characteristics such as primary versus secondary seatbelt laws, road density, traffic density, and rurality.

We first used random-effects multivariate regression for panel data, incorporating the small-sample Swamy–Arora estimator individual-level variance component and clustered (by state) robust SEs, to confirm

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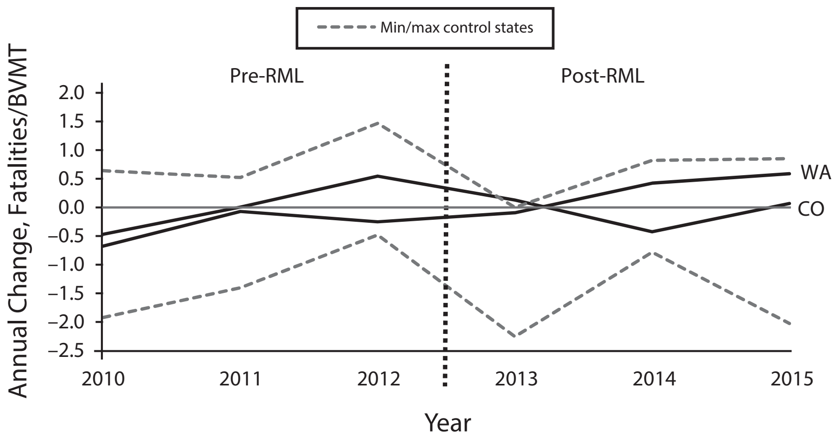
parallel trends for the pre–recreational marijuana legalization (2009–2012) changes in motor vehicle crash fatality rates for Washington and Colorado and for the control states. We then modeled the interaction effect between recreational marijuana legalization (yes/no) and period (pre–/post–recreational marijuana legalization) on changes in motor vehicle crash fatality rates for the full study period (2009–2015), which produced the difference-in-differences coefficient. Positive difference-in-differences coefficients indicate higher motor vehicle crash fatality rates (smaller decreases or larger increases); negative coefficients indicate lower rates (larger decreases or smaller increases). We used the Hausman test to confirm appropriateness of the model specification. All tests were 2-sided with an α value of .05 used to establish statistical significance.



Note. min = minimum; max = maximum.

FIGURE 1—Annual Year-Over-Year Changes in Motor Vehicle Crash Fatality Rates per Billion Vehicle Miles Traveled (BVMT) Before and After Recreational Marijuana Legalization (RML): Washington (WA), Colorado (CO), and 8 Control States, 2010–2015

RESULTS

Alabama, Indiana, Kentucky, Missouri, South Carolina, Tennessee, Texas, and Wisconsin were the 8 states without either medical marijuana legalization or recreational marijuana legalization that most closely matched Washington and Colorado in terms of traffic, roadway, and population characteristics. Between 2009 and 2015, 60 737 motor vehicle crash fatalities occurred in Washington, Colorado, and the 8 control states. Overall, annual motor vehicle crash fatality rates decreased from 12.8 fatalities per billion vehicle miles traveled in 2009 to 11.4 fatalities per billion vehicle miles traveled in 2015.

Figure 1 shows the year-over-year changes in motor vehicle crash fatality rates for Washington and Colorado versus the control states in both the pre– and the post–recreational marijuana legalization periods. In the pre–recreational marijuana legalization period, the mean (±SD) year-over-year changes observed in Washington and Colorado did not differ from those observed in the control states (–0.2 [±0.4] vs –0.1 [±0.9] fatalities/billion vehicle miles traveled; $P = .38$). After legalization, motor vehicle crash fatality rates increased by a mean of +0.1 (±0.4) fatalities per billion vehicle miles traveled in Washington and Colorado and decreased by a mean of –0.5 (±0.9) fatalities per billion vehicle miles traveled in the control states each year. In the adjusted difference-in-differences analysis, however, the postlegalization changes in motor vehicle crash fatality rates observed in Washington and Colorado were not significantly different from those observed in the control states (difference-in-differences: +0.2; 95% confidence interval = –0.4, +0.9). (A summary of the results and the full regression model are shown in Appendix B, available as a supplement to the online version of this article at http://www.ajph.org.) Post hoc analyses that used nonclustered robust SEs, traditional random-effects regression, fixed-effects regression, or population rather than billion vehicle miles traveled as the denominator or that grouped Washington with its most similar control states and Colorado with its most similar control states all produced similar results (data not shown).

DISCUSSION

We found no significant association between recreational marijuana legalization in Washington and Colorado and subsequent changes in motor vehicle crash fatality rates in the first 3 years after recreational marijuana legalization. The difference-in-differences coefficient we observed, 0.2 fatalities per billion vehicle miles traveled, would equate to approximately 77 excess crash fatalities (of 2890 total) over nearly 38 million person-years of exposure in the 3 years since legalization. We do not view that as a clinically significant effect, but others might disagree. Although our findings seem at odds with the known effects of marijuana impairment[8,9] and with previous studies finding associations between motor vehicle crashes and marijuana use,[2–5] they are consistent with the most recent analysis of medical marijuana legalization and motor vehicle crash fatalities.[1]

This study was limited to the first few years after recreational marijuana legalization in only 2 states. Currently, however, Washington and Colorado are the only US states with multiyear postlegalization FARS data, and 2015 is the last year for which data are available. We used nonadjacent control states matched to Washington and Colorado based on traffic, roadway, and population characteristics, allowing a stronger analysis than if we had used adjacent, randomly selected, or a convenience sample of states as controls. All of the states had graduated drivers' licensing laws and used 0.08 grams per deciliter as their blood alcohol concentration threshold for impaired driving; all but 1 state (Tennessee) allowed administrative license revocation for impaired driving. Still, states are inherently unique and dynamic, and other unmeasured factors (e.g., enforcement activities; other laws and policy initiatives) could affect crash fatality rates. Selecting fewer control states could have provided for greater similarity between Washington and Colorado and the control states but would have increased the risk of selection bias. We selected control states without medical marijuana legalization to provide the greatest opportunity to detect an effect of recreational marijuana legalization, presuming the difference between marijuana illegality and recreational marijuana legalization is likely greater than the difference between medical marijuana legalization and recreational marijuana legalization. We did not evaluate the effects of recreational marijuana legalization in Washington and Colorado separately, although their recreational marijuana legalization laws differ somewhat. Finally, we were unable to differentiate between the effects of recreational marijuana legalization (2012) and the effects of legalization of commercial marijuana sales (2014)—an issue deserving of future study.

Importantly, the absence of a statistically significant effect on motor vehicle crash fatality rates does not mean that recreational marijuana legalization is harmless. We did not assess other public health or policy implications of recreational marijuana legalization such as increased drug dependency, emergency department or rehabilitation center admission rates, suicides, or decreased economic productivity. A recent study reported increased marijuana-related emergency department visits among out-of-state visitors to Colorado following recreational marijuana legalization.[10]

This analysis was based on annual statewide motor vehicle crash fatality and billion vehicle miles traveled data; we were not able to evaluate possible differential effects in subpopulations such as younger versus older drivers or rural versus urban drivers. We studied total crashes rather than marijuana-impaired crashes because testing for marijuana use is not uniform in FARS-reported crashes, and the limitations of laboratory testing make studies of marijuana-impaired crashes difficult.[11] Also, FARS does not report nonfatal crashes, and no nationwide clearinghouse for nonfatal crash data is available. However, we also found no association between recreational marijuana legalization and total crash rates when analyzing available state-reported nonfatal crash statistics (Appenix C, available as a supplement to the online version of this article at http://www.ajph.org).

PUBLIC HEALTH IMPLICATIONS

We conclude that 3 years after recreational marijuana legalization in Washington and Colorado, the changes in motor vehicle crash fatality rates observed in those 2 states do not significantly differ from rate changes in similar states without recreational marijuana legalization. However, future studies over a longer time, including data from additional states with recent recreational marijuana legalization, remain warranted. AJPH

CONTRIBUTORS

J. D. Aydelotte and K. M. Luftman conceptualized the study. J. D. Aydelotte, L. H. Brown, K. M. Luftman, B. Coopwood, and C. V. R. Brown designed the study. L. H. Brown, K. M. Luftman, and A. L. Mardock acquired the data. J. D. Aydelotte, L. H. Brown, K. M. Luftman, P. G. R. Teixeira, and C. V. R. Brown analyzed and interpreted the data. J. D. Aydelotte, L. H. Brown, and K. M. Luftman drafted the article, and A. L. Mardock, P. G. R. Teixeira, B. Coopwood, and C. V. R. Brown provided additional critical revisions and intellectual content. All authors reviewed and approved the final version of the article.

HUMAN PARTICIPANT PROTECTION

The institutional review board affirmed that this study was not human participant research.

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Drug Recognition Expert (DRE) examination characteristics of cannabis impairment

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ABSTRACT

Background: The Drug Evaluation and Classification Program (DECP) is commonly utilized in driving under the influence (DUI) cases to help determine category(ies) of impairing drug(s) present in drivers. Cannabis, one of the categories, is associated with approximately doubled crash risk. Our objective was to determine the most reliable DECP metrics for identifying cannabis-driving impairment.
Methods: We evaluated 302 toxicologically-confirmed (blood Δ^9-tetrahydrocannabinol [THC] $\geq$1 μg/L) cannabis-only DECP cases, wherein examiners successfully identified cannabis, compared to normative data (302 non-impaired individuals). Physiological measures, pupil size/light reaction, and performance on psychophysical tests (one leg stand [OLS], walk and turn [WAT], finger to nose [FTN], Modified Romberg Balance [MRB]) were included.
Results: Cases significantly differed from controls ($p < 0.05$) in pulse (increased), systolic blood pressure (elevated), and pupil size (dilated). Blood collection time after arrest significantly decreased THC concentrations; no significant differences were detected between cases with blood THC <5 μg/L versus $\geq$5 μg/L. The FTN best predicted cannabis impairment (sensitivity, specificity, positive/negative predictive value, and efficiency $\geq$87.1%) utilizing $\geq$3 misses as the deciding criterion; MRB eyelid tremors produced $\geq$86.1% for all diagnostic characteristics. Other strong indicators included OLS sway, $\geq$2 WAT clues, and pupil rebound dilation. Requiring $\geq$2/4 of: $\geq$3 FTN misses, MRB eyelid tremors, $\geq$2 OLS clues, and/or $\geq$2 WAT clues produced the best results (all characteristics $\geq$96.7%).
Conclusions: Blood specimens should be collected as early as possible. The frequently-debated 5 μg/L blood THC per se cutoff showed limited relevance. Combined observations on psychophysical and eye exams produced the best cannabis-impairment indicators.

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1. Introduction

Drugged driving increased in recent decades, even as driving under the influence (DUI) of alcohol decreased (Berning et al., 2015). In the recent 2013–2014 National Roadside Survey, drug prevalence in weekend nighttime drivers increased to 20.0% from 16.3% in 2007 (Berning et al., 2015). In an effort to combat drugged driving, the Drug Evaluation and Classification Program (DECP) was developed by the US Department of Transportation National Highway Traffic Safety Administration (NHTSA) and the International Association of Chiefs of Police (IACP) (International Association of Chiefs of Police, 2013a, 2015a, 2015b). When an officer suspects alcohol or drug impairment at the roadside based upon observations and results of standardized field sobriety tests (SFSTs; i.e., horizontal gaze nystagmus [HGN], one-leg stand [OLS], and walk and turn [WAT] tests validated to predict 0.08% blood alcohol concentration [BAC] (Stuster and Burns, 1998; Stuster, 2006)), the arrest is made and a drug recognition expert (DRE) evaluation is requested when the suspect's BAC is not consistent with observed impairment. A DRE is a police officer trained in the DECP and certified to conduct examinations of drug-impaired drivers. The DRE drug influence evaluation occurs at a precinct, jail or similar location as soon as possible (Richman et al., 2004). DREs utilize a standardized 12-step procedure combining medical, psychophysical, and observational evidence to formulate an opinion regarding

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the drug category(ies) (CNS depressants, CNS stimulants, hallucinogens, dissociative anesthetics, narcotic analgesics, inhalants, cannabis) likely causing the impairment (Clarkson et al., 2004; Cochems et al., 2007; Heishman et al., 1996; Kunsman et al., 1997; Logan, 2009; Richman et al., 2004; Smith et al., 2002).

Cannabis, the most common illicit drug detected in drivers (Berning et al., 2015; Legrand et al., 2013; Pilkinton et al., 2013), is associated with approximately doubled crash risk (Asbridge et al., 2012; Li et al., 2012). Its prevalence increased 48% in weekend nighttime drivers since 2007, with 12.6% positive for its primary psychoactive compound Δ^9-tetrahydrocannabinol (THC) in blood and/or oral fluid (Berning et al., 2015). However, polypharmacy is common and cannabis is often detected in combination with other drugs (Legrand et al., 2013); this presents challenges for evaluating impairment due to cannabis only. Cannabis impairs divided attention, a crucial driving skill, particularly in occasional smokers (Ramaekers et al., 2009; Theunissen et al., 2012; Desrosiers et al., 2015). The 12-step DRE evaluation includes four tests specifically designed to target and challenge this ability. Previous research evaluated SFST performance for cannabis after controlled administration, with mixed results (Bosker et al., 2012a, 2012b; Downey et al., 2012; Papafotiou et al., 2005a, 2005b). However, limited data exist evaluating cannabis-impaired individuals undergoing the full DRE evaluation (Heishman et al., 1996; Schechtman and Shinar, 2005).

The objective of this investigation was to evaluate toxicologically confirmed cannabis-only cases for which DRE examinations were conducted and cannabis intake successfully identified. In these cases, the officer's opinion was cannabis impairment only, providing data to identify cannabis' characteristic effects on cognitive and psychomotor function. We sought to determine the most reliable DECP metrics and optimal combinations of metrics for identifying cannabis driving impairment. To achieve this aim, our approach was to examine the most cannabis-sensitive outcomes for combinations of observations with discrete outcomes that produced the best overall cannabis impairment indication.

2. Methods

2.1. Study population

Inclusion criteria for this investigation were: cases with an available complete DRE evaluation, including face sheet and narrative report that contained the reason for the traffic stop; DRE opinion reporting impairment by cannabis only; no breath alcohol detected; blood toxicological results reporting quantifiable THC, with no non-cannabinoid drugs detected; and suspect did not admit to taking any drugs other than cannabis (to prevent self-reported cannabis intake as the reason for correct identification). Individuals aged ≥60 years were excluded from cases and controls (International Association of Chiefs of Police, 2013a, 2015a), because of possible age limitations described in the original SFST validation studies and included in the SFST training curricula (Stuster, 2006; Stuster and Burns, 1998).

2.2. Control population

Police officers and volunteers evaluated as part of DRE training programs served as a comparison group for these data. Although toxicology was not performed, all police officers reported no impairing drug use. For all controls, the DRE opinion was "not impaired".

2.3. Evaluation procedures

The DECP evaluation process is a systematic, standardized 12-step procedure based on observable signs and symptoms to determine (a) whether a suspect is impaired; (b) whether impairment is due to drugs or a medical condition; and c) if drugs are suspected, the category(ies) likely causing impairment (International Association of Chiefs of Police, 2013a, 2015a, 2015b). The 12 steps include: (1) breath alcohol test, (2) DRE interview of the arresting officer, (3) preliminary examination and first pulse, (4) eye examination (including HGN, vertical gaze nystagmus [VGN], and lack of convergence [LOC] tests), (5) divided attention psychophysical tests (including Modified Romberg Balance [MRB], WAT, OLS, and finger to nose [FTN]), (6) vital signs (including blood pressure, body temperature, and second pulse reading), (7) dark room examinations (pupil examination under three different lighting conditions: room light, near-total darkness, and direct light), (8) muscle tone examination, (9) check for injection sites and third pulse, (10) interview of the suspect, (11) analysis and opinions of the evaluator, and (12) toxicological examination. Detailed descriptions of each step are presented in Supplemental Text and previous publications (Richman et al., 2004; Smith et al., 2002).

The psychophysical tests challenge suspects' coordination and ability to divide attention and follow directions. In each exam, the DRE provides instructions and asks whether the suspect understands the instructions. The MRB test consists of standing with feet together, head tilted backward with eyes closed, and estimating the passage of 30 s. This modified version of the Romberg Test (Richman, 2010) detects the inability to maintain a steady standing posture with eyes closed, as well as divided attention and time sense impairment. Documented observations include body sway and direction, actual time elapsed over the suspect's estimated 30 s, and eyelid and body tremors. The WAT requires the suspect to take nine heel-to-toe steps along a straight line, counting steps aloud, followed by turning in a prescribed manner [turning on the planted foot using a series of small steps with the opposite foot] and returning in the opposite direction in the same fashion. The eight possible impairment clues are: losing balance during instructions, starting too soon (prior to instruction to start), stopping while walking, missing heel-to-toe, stepping off the line, using arms to balance, incorrect number of steps, and improper/incorrect turn. The "impairment" criterion is ≥2 WAT clues. Other observations such as tremors also are recorded. The OLS involves standing with one foot ∼6″ off the floor, and counting aloud by thousands ("one thousand one..." etc.) until told to put the foot down (30 s timed). Clues are body sway, using arms to balance, hopping, or putting foot down (≥2 clues is "impairment" criterion). Additional observations (tremors and the count reached in 30 s) also are recorded. In the FTN test, the suspect attempts to touch the tip of his/her nose with the tip of the index finger 6 times (3 per hand); number of misses (missed fingertip-to-nose tip or incorrect part of finger utilized) were recorded (6 maximum).

The eye examination consists of oculomotor control and eye convergence assessment. HGN comprises three measures of eye movement function integrity: lack of smooth pursuit (eyes' ability to fixate and track a moving target smoothly); nystagmus at maximum deviation (ability to hold eyes steady in fixed position on a non-moving target without nystagmus [involuntary jerking of the eye]); and nystagmus onset prior to 45° (ability to fixate and track a slow-moving target without nystagmus). A maximum of six clues may be recorded (3/eye). VGN assesses presence/absence of nystagmus at maximum deviation in upward vertical gaze. LOC assesses the eyes' inability to converge ("cross") while attempting to focus on a stimulus pushed slowly toward the bridge of the nose. LOC was present if the subject could not converge the eyes to a minimum of 2 inches from the bridge of the nose. The examiner applied the standardized methods (Citek et al., 2003; International Association of Chiefs of Police, 2013b, 2015a, 2015b) for the HGN, VGN, and LOC exams, scoring the presence or absence of the requisite signs or clues. The dark room examination (Step #7) requires the examiner to estimate and evaluate pupil size with a card pupillometer. This type of pupillometer has a series of circles or semi-circles with diameters ranging from 1.0–10.5 mm in half-millimeter increments. The pupillary responses and size are measured under three lighting conditions: room light (RL), near-total darkness (NTD), and direct light (DL). The pupils' reaction and response to light are observed and recorded. During DL testing, the eye is observed for 15 s with a pupillometer in position before recording the observed pupil size. The examiner checks for rebound dilation (brief pupillary constriction during the first seconds of DL, followed by pupillary dilation wherein pupil size steadily increases and does not return to its original constricted size) and records its presence or absence. Rebound dilation is differentiated from normal pupillary unrest (continuous, irregular change in pupil size that may be observed under room or steady light conditions). Rebound dilation may occur in persons impaired by drugs that cause pupillary dilation. Of the seven drug categories that are evaluated in the DECP protocols, cannabis most frequently exhibits rebound dilation (International Association of Chiefs of Police, 2015b).

The DRE utilizes the combined results from all observations in the 12-step DECP to formulate an overall opinion on whether the driver is impaired and if so, which (if any) of the drug categories is/are the source(s) of the impairment. Because the DECP is designed to assess for impairment from multiple different drug classes, not every measurement taken during the DECP 12-step program is expected to be cannabis-sensitive and specific. Additionally, as it would be inappropriate to base an opinion of impairment solely on one or two outcome measures, the DRE utilizes combined results from all of the various tests and observations throughout the 12-step program to formulate an opinion.

2.4. Blood analysis

Blood THC was quantified by local forensic laboratories' standard analytical procedures. For study consistency, a quantifiable 1 μg/L blood THC cutoff was established for all laboratories.

2.5. Data analysis

Statistical analyses were performed with GraphPad Prism 6 (La Jolla, CA). To determine how blood collection timing in the DRE process affected measured THC concentrations, cases were categorized according to whether blood collection occurred before, during, or after the evaluation. A Kruskal-Wallis test with Dunn's test (post-hoc multiple comparisons) evaluated THC concentrations according to these categories (before, during, after DRE evaluation). Spearman's r correlation was utilized to assess the effect of post-arrest time on measured blood THC concentration. Fisher's exact test was utilized to compare frequency of crash and/or moving violations as the cause of traffic stop when blood THC <5.0 μg/L versus when blood THC $\geq$5.0 μg/L.

Overall comparisons between cannabis cases and controls were performed by Mann-Whitney *U* analyses. Within-subject left-vs.-right comparisons were performed by Wilcoxon matched-pairs tests. Performance at blood THC concentrations relative to proposed 5 μg/L THC per se cutoffs were compared via Kruskal-Wallis one-way ANOVA (groups: controls, THC <5 μg/L [n = 114], THC $\geq$5 μg/L [n = 188]) with all three post-hoc comparisons (Dunn's multiple comparisons correction).

To evaluate which tests and combinations best predicted cannabis impairment, we evaluated diagnostic test characteristics (sensitivity, specificity for impairment identification, positive and negative predictive value [PPV/NPV], and efficiency) for psychophysical tests and other frequently detected signs. Because the study's premise was that cases were successfully-identified cannabis impairment confirmed by cannabis-only toxicology and controls were self-reported drug-negative individuals called "non-impaired" by DREs, true positives (TP) were defined as DRE cases (impaired) that exhibited a given attribute; true negatives (TN), controls (non-impaired) who did not exhibit the attribute; false negatives (FN), cases which did not display the sign; and false positives (FP), controls who displayed the sign. Sensitivity is defined as TP/(TP + FN); specificity, TN/(TN + FP); PPV, TP/(TP + FP); NPV, TN/(TN + FN); efficiency, (TP + TN)/(TP + TN + FP + FN). As FTN and MRB are not yet validated, we evaluated various outcome measures for diagnostic efficacy. "Impairment" criteria (validated for 0.08% blood alcohol concentration (Stuster, 2006)) utilized by DREs on the WAT and OLS are $\geq$2 distinct clues; we based our evaluation upon those metrics. Because the DECP evaluates multiple drug classes and takes into account several types of impairment indicators, we also evaluated diagnostic characteristics combining multiple impairment indicators.

3. Results

Three hundred two cannabis DRE cases collected from 2009 to 2014 were included in this investigation, and 302 controls obtained over the same time period for comparison (Table 1). Cases were significantly younger than controls ($p < 0.001$), but sex distribution did not significantly differ. Drivers (cases) originated from nine US states: Arizona, (101), California (3), Colorado (14), Montana (19), New Mexico (11), Pennsylvania (20), Texas (3), Washington (119) and Wisconsin (12); controls were obtained from California, Texas, Oklahoma, New Mexico, and Kansas. Twenty-six cases (8.6%) from four states (Washington, 14; Arizona, 5; Colorado, 5; Montana, 2) were from drivers with medical marijuana cards. Mean pulse (over three repetitions throughout the exam) was significantly higher in cases (median [range] 91 [49–166] bpm) than controls (71 [39–107]), $p < 0.001$ (Table 1). Mean pulse was $\geq$90 bpm in 53.6% of cases, but only 5.6% of controls. Systolic blood pressure also was significantly higher in cases (138 [82–205] vs. 130 [90–170] mmHg, $p < 0.001$), but diastolic blood pressure was not ($p = 0.570$).

Case distributions of arrest time, driver age, time between arrest and start of evaluation, time between arrest and blood collection, blood THC concentration, and reasons for traffic stops are presented in Fig. 1. Most (54.6%) arrests occurred between 9:00 PM-3:00 AM, and most (70.9%) drivers were 18–25 years old. In 72.3% of cases, one or more moving violations were listed as reasons for the traffic stop. Moving violations included improper speed (27.7%), weaving (19.0%); crash (9.3%), improper turn (7.7%), disobeying traffic control devices (7.0%), and failure to yield (3.3%). Other cited reasons included equipment failure such as headlight or taillight defects (10.3%), expired vehicle license (3.7%), criminal activity such as observable cannabis smoking or driving in prohibited areas (2.7%), and other (11.3%). In all but one of the improper speed cases, the suspect was reported driving faster than the posted limit. The one case reported driving slower than the limit also was drifting within the lane. In 72.3% of cases, the officer detected a cannabis odor; 35.3% of drivers had cannabis in their possession. In 23.3% of cases, neither cannabis odor nor possession was reported. For the 97 cases where the officer reported the suspect's demeanor, the most common were "relaxed" (34.0%), "lethargic" (21.6%), "slow" (17.5%), and "carefree" (6.2%). Other adjectives ($\leq$3 cases) reported included "sluggish", "laughing", "restless", "emotional", "dazed", "shaking", "rigid", "disoriented", "sleepy", "anxi[ous]" or "withdrawn". The most common adjectives reported for controls were

Table 1
Median [range] or prevalence of demographic characteristics, pulse, body temperature, and blood pressure for 302 cannabis-only Drug Recognition Expert (DRE) cases and 302 controls (police officers and police academy students, volunteers) evaluated.

		Cases	N	Controls	N	p-value	DRE Non-Impaired "Average" and/or "Average Range"[a]
Age (years)		21 [15–59]	302	34 [15–59]	282	**<0.001**	–
Sex		87.4% M, 12.6% F	302	89.2% M, 10.8% F	295	0.5272	–
Race/Ethnicity	A/PI	2.3%	7	3.3%	9		–
	B	10.6%	32	3.5%	10		–
	H	19.2%	58	17.8%	52		–
	I	2.0%	6	0.3%	1		–
	W	65.6%	198	74.9%	218		–
	O	0.3%	1	0.6%	2		–
Body Temperature (°F/°C)		98.3[93.8–100.6]/36.8 [34.3–38.1]	295	98.3 [94.0–99.3]/36.8 [34.4–37.4]	300	0.0749	98.6(97.6–99.6)/37.0 (36.4–37.6)
Pulse[b] (bpm)		91 [49–166]	302	71 [39–107]	302	**<0.001**	(60–90)
SBP		138 [82–205]	300	130 [90–170]	302	**<0.001**	(120–140)
DBP		80 [42–110]	300	80 [36–120]	302	0.5696	(70–90)

Values are reported for all cases where data were available (N indicates number of cases or controls with data available). Boldface indicates statistical significance at $p < 0.05$.
Abbreviations: A/PI, Asian/Pacific Islander; B, Black or African American; H, Hispanic; I, Indian; W, White; O, Other; SBP, systolic blood pressure; DBP, diastolic blood pressure.
[a] Language utilized in DRE program.
[b] Pulse is mean pulse for each individual, across three measurements.

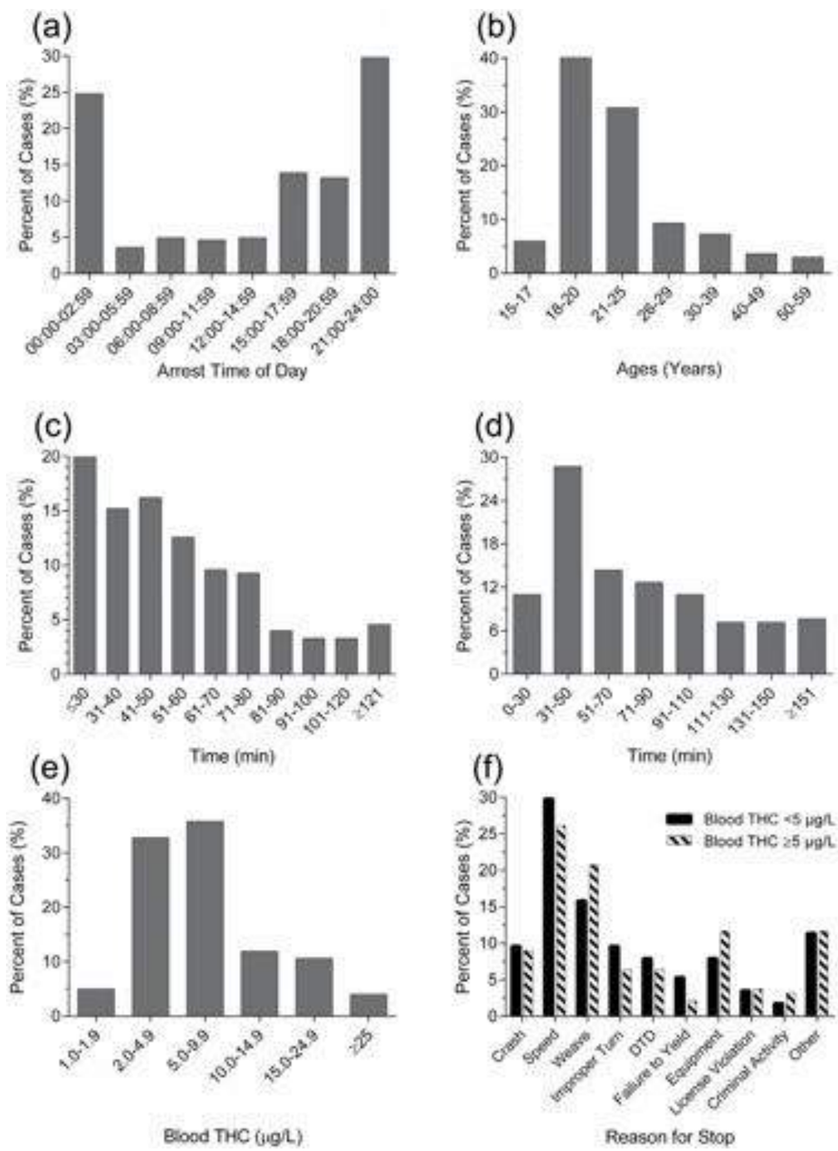

Fig. 1. Case distribution of (a) arrest time of day, (b) ages, (c) time from arrest to start of drug recognition expert (DRE) evaluation, (d) time from arrest to blood collection, (e) blood Δ^9-tetrahydrocannabinol [THC] concentration, and (f) reasons for the traffic stop, for 302 suspected drugged drivers who underwent DRE evaluation and tested positive for cannabis only. Abbreviation: DTD, disobeyed traffic device (e.g., stop sign, traffic signal).

"cooperative" (70.0%), "calm" (14.8%), "good" (9.1%), "normal" (5.7%), and "relaxed" (3.7%).

Median [range] elapsed time between arrest and evaluation start was 47.5 [2–189] min, with 21.9% of case evaluations commencing within a half hour and 67.7% within an hour post-arrest (Fig. 1c). Evaluation duration was 43 [20–150] min, with 58.6% of evaluations lasting 31–50 min. Median [range] measured blood THC concentration was 6.0 [1.0–47.0] μg/L. Most drivers' blood THC was 5.0–9.9 μg/L (35.8%), with 32.8% between 2.0–4.9 μg/L. Only 5.0% had blood THC <2 μg/L. There was information about blood collection time for 180 cases; median [range] time from arrest to blood collection was 61 [0–225] min. Blood collection time relative to the DRE evaluation (before/during/after) significantly affected measured THC concentrations ($p = 0.034$) overall (Fig. 2), with blood collected before the evaluation showing significantly greater ($p = 0.030$) concentrations (median [range] 7.1 [1.1–35.0] μg/L, $n = 91$) than blood collected after the evaluation (5.0 [1.1–47] μg/L, $n = 72$). Increasing blood collection time (relative to arrest) was significantly correlated with decreasing measured blood THC (Spearman r, −0.2317; $p = 0.0017$). No significant differences were detected in incidence of moving violations or any specific type of moving violation between drivers with blood THC quantified ≥5 μg/L and those with THC <5 μg/L.

MRB, WAT, and OLS results are presented in Fig. 3. In the MRB, drivers' estimation of 30 s was variable with wide distribution (median [range] 29 [4–90] s), whereas controls' estimations were more normally distributed (30 [20–53] s). Overall, a significant difference in time estimation was detected ($p = 0.002$), with only 4.0% of cases' estimations coinciding with exactly 30 s on the clock, compared to 29.9% of controls. However, cases' over- and under-estimation prevalences were approximately equal (31.1% over and 36.1% under 30 s by >10%), and 50.7% of cases (controls, 83.1%) estimated 30 s within ±5 s. In 78.5% of cases' MRB tests, sway (front-to-back, side-to-side, or both) was documented, compared with only 11% of controls. In 28.8% of cases, both side-to-side and front-to-back sway were noted; circular sway was recorded for 22.8% of cases. Eyelid tremors were observed in 57.9% of cases during the MRB, and an additional 28.1% displayed eyelid and body tremors. On the WAT, median [range] number of clues (8 possible) were 3 [0-8] for cases and 0 [0–2] for controls ($p < 0.001$). The most distinctive clue for the WAT was improper turn, detected in 57.3% of cases and 0% of controls. Other common cannabis WAT clues included using arms to balance (43.7% cases/2.3% controls), stopping (41.4%/2.0%), and missing heel-to-toe (41.1%/3.0%). WAT tremors were observed in 17.5% of cases and 0% of controls. Similar patterns emerged for the OLS. Of 4 possible OLS clues, the median number of observed clues (on either left or right leg) for cases was 1 versus 0 for controls ($p < 0.001$), with a broader distribution. No significant differences in reported clues were noted between left and right legs; however, some *individuals* had a higher number of clues for one leg than the other. Thus, although the medians for each leg [n(R) = 302, n(L) = 302] and all trials collectively [n = 604] were 1, 55.0% of drivers (cases) demonstrated ≥2 clues on at least one leg. Fewer than 20% of cases had 0 observed clues, compared to >90% of controls. Sway was the most common OLS clue detected, followed by using arms to balance (Fig. 3). Cases counted significantly faster on the second attempt (right leg) than on the first (left). Median [range] count reached in 30 s were: cases, 24 [10–40] left/24 [13–56] right, $p = 0.027$. Although controls' left versus right counts also significantly differed ($p = 0.040$), distributions tightened on the second attempt: 29 [16–36] left/30 [17–35] right. Cases' versus controls' counts significantly differed ($p < 0.0001$) for left and right legs. Although tremors are not considered a "clue" in any DRE test, they were a recorded observation in 63.4% of cases' OLS tests. Cases and controls displayed opposing patterns for number of "misses" (unsuccessful attempts [including missing the tip of the nose and using the pad, rather than tip, of the finger], out of 6 possible misses) on the FTN (Fig. 4). Cases missed substantially more than controls (median [range] 5 [0–6], 0 [0–6] respectively, $p < 0.0001$). Both eyelid and body tremors were documented for 23.8% of cases (0 controls), and eyelid tremors only in 39.7% of cases (0.7% controls). There was no correlation between THC concentration and tremors observations (eyelid, body, or both) in the OLS, WAT, MRB, or FTN tests (Spearman r = −0.0421–0.0744, p ≥ 0.198). No significant differences were detected in test results between cases with blood THC measured ≥5.0 μg/L and those with <5 μg/L (Supplemental Figs. 1 and 2).

Cases' mean (SD) pupil size was significantly more dilated than controls ($p < 0.001$) in RL, NTD, and DL (Fig. 5a). Mean values for controls were, in effect, the same as those for DRE pupil size average [unimpaired] ranges (International Association of Chiefs of Police, 2015b), whereas mean values for cases exceeded them. HGN occurrence did not significantly differ between cases and controls (2.65% vs. 0.33%, respectively, $p > 0.05$ [Fig. 5b]). VGN was not detected in controls or cases. LOC and rebound dilation occurred significantly more ($p < 0.001$) in cases (78.8% and 70.9%, respectively) than controls (10.9% and 1.0%).

Results of our evaluation of metrics and combinations to predict cannabis impairment are presented in Table 2. At least 3 FTN misses produced the overall best diagnostic performance characteristics on that test, and the observation of MRB eyelid tremors showed good sensitivity (86.1%), specificity (94.0%), and PPV (93.5%). Overall, the best single impairment indicators (efficiency ≥89.1%) were ≥3 FTN misses, MRB eyelid tremors, sway during the OLS, and ≥2 clues on the WAT. All demonstrated sensitivity ≥80.5%, ≥92.4% specificity, and PPV ≥91.8%. Rebound dilation occurred in 70.9% of cases and no controls; LOC had higher sensitivity (78.8%) than rebound dilation, but specificity was 89.1% and PPV 87.8%. In the evaluation of combined metrics, rebound dilation *or* LOC produced high performance characteristics (all ≥89.1%). The best overall result (all performance characteristics ≥96.7%) arose from requiring ≥2/4 of the following: ≥3 FTN misses, MRB eyelid tremors, ≥2 OLS clues, and/or ≥2 WAT clues.

4. Discussion

For approximately thirty years, the DRE program has applied a comprehensive, systematic, and standardized 12-step evaluation consisting of physical, mental and medical components for determining presence of possible drug-related driving impairment (International Drug Evaluation and Classification Program, 2016). Since the expansion of the DECP in the US and Canada, other countries, such as the United Kingdom, China, and Germany incorporated many aspects of the DECP. The United Kingdom uses two drug recognition systems, the field impairment testing (FIT) and drug recognition training (DRT) protocols (Jackson et al., 2000; Department for Transport, 2004) to identify the signs and symptoms associated with drug effects and the driver's possible drug impairment. A number of FIT and DRT procedures were adapted from the DRE protocol in the United States (Jackson et al., 2000; Department for Transport, 2004). Some differences between the US DECP and other countries' protocols include: (1) Training: In the US, the three-phase training process to assess physical, mental and medical components requires approximately 100 h, including extensive written and practical field testing for the officer to be certified as a DRE. In addition, recertification is required every two years (International Drug Evaluation and Classification Program, 2016). In other drug impairment training programs such as FIT and DRT in the UK, the training is much less time-intensive but also requires that portions of the drug-impairment assessment be conducted by a forensic medical examiner or physician (Sancus

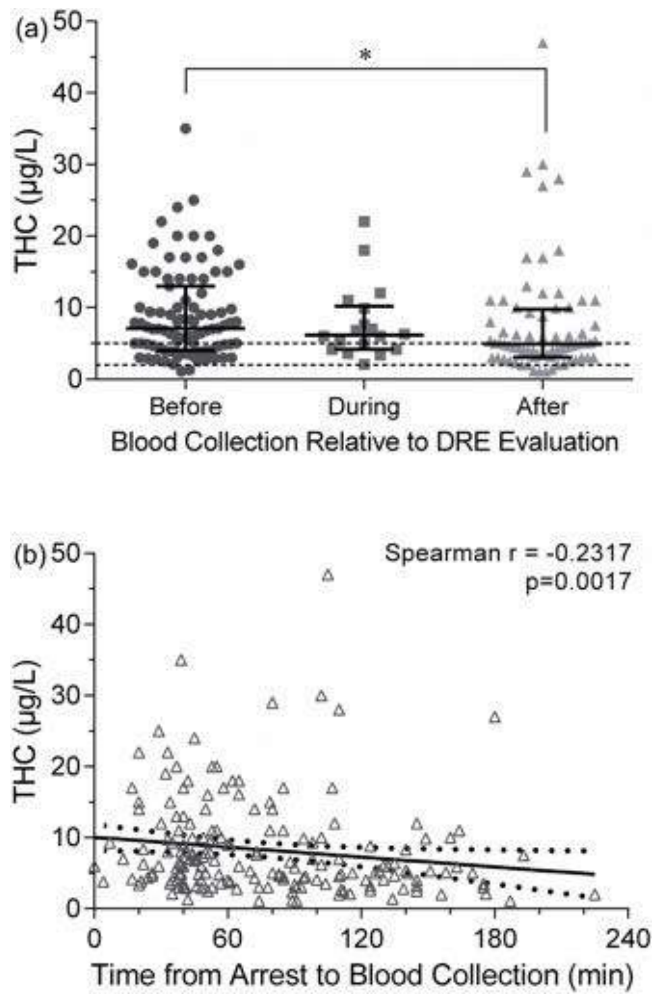

Fig. 2. Distribution of blood Δ^9-tetrahydrocannabinol [THC] concentrations a) collected before, during, or after Drug Recognition Expert (DRE) evaluation with median [interquartile range] indicated; and b) correlation with time between arrest and blood collection. *THC concentrations measured in blood collected before DRE evaluations were significantly greater than THC measured in blood collected afterward (p = 0.030). Dotted lines in (a) represent 2 and 5 μg/L THC, commonly debated per se cutoffs. Dotted lines in (b) represent 95% confidence interval in correlation line displayed.

Solutions, 2016). (2) Assessment: In the US, a police officer uses the SFSTs at roadside to identify impairment. Based on the results of the SFSTs, the officer may decide to arrest and charge the suspect for DUI, not always knowing the cause of the impairment. Once a breath test is obtained and if alcohol is not involved, a DRE is often summoned to conduct a drug evaluation under controlled conditions in the police station. In other countries, the police officer applies the information from the stop and field impairment tests. If impairment is suspected, the officer makes the arrest. What follows varies per country (Hughes, 2007). An outside resource is consulted and requested to continue the assessment, to assist in determining if the driver's condition may be due to alcohol or drugs. If determined due to drugs, a toxicological sample is acquired for drug analysis and the suspect is charged accordingly (Hughes, 2007). (3) Decision process: DREs use an extensive systematic and standardized process that is recognized in many courts in the United States to determine the possible presence of impairment and its likely cause. In other countries, the testing and decision protocols used to determine possible drug impaired driving vary and are designed, organized, and applied according to their respective laws (Hughes, 2007; International Police Association-IAC, 2012; Oliver et al., 2006).

Our data are among the most comprehensive cannabis-impaired DRE evaluation results ever established, and will help inform drug impairment identification techniques worldwide. We successfully collected 302 full DRE evaluations from cannabis-only cases to establish a population profile of driver impairment due to cannabis. In DUI cases, although cannabis is the most common illicit drug identified (Berning et al., 2015; Legrand et al., 2013; Pilkinton et al., 2013), it is difficult to obtain cannabis-only cases. This requirement historically restricted n in cannabis-impaired driving studies (Drummer et al., 2004). For the first time to our knowledge, >300 cannabis-only DRE cases (in which the DRE's opinion correctly [toxicologically confirmed] identified cannabis) were amassed for evaluation, with a size-matched control population providing normative data. With this study population, we were able to observe statistically significant differences between cases and controls. Our controls were consistent with DRE-established "average ranges" (International Association of Chiefs of Police, 2015a), while the cases significantly differed in several characteristics including pulse, SBP, and pupil size. Another unique aspect of this research is our evaluation of FTN and MRB results best indicating cannabis impairment, as these psychophysical tests are not yet validated.

Cannabis-driving legislation is increasingly debated as medical and recreational cannabis use expand (ProCon.org, 2014; Salomonsen-Sautel et al., 2014; Urfer et al., 2014). Blood THC zero-tolerance or per se thresholds are under consideration in several jurisdictions and already adopted in 14 states (Armentano, 2013). Blood THC ≥5 μg/L is a commonly considered per se threshold.

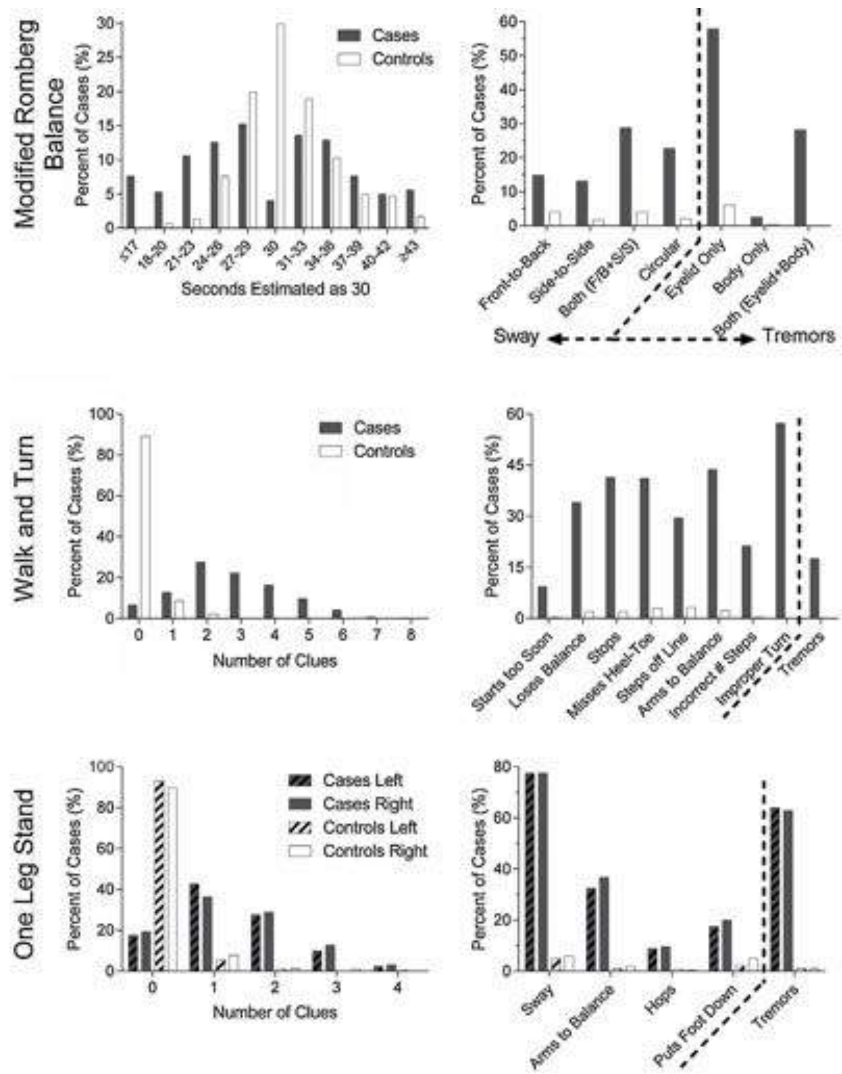

Fig. 3. Case (N = 302) and control (N = 302) frequency distribution of performance measures on Modified Romberg Balance (MRB), Walk and Turn (WAT), and One Leg Stand (OLS) psychophysical tests. For MRB, observations include number of seconds estimated as 30 s, front-to-back (F/B) and side-to-side (S/S) sway, and tremors. For the WAT and OLS, number of distinct "clues" detected are provided on the left graph, with specific clues on the right. Dotted lines separate tremors; WAT and OLS tremors are recorded observations, *not* clues. For the OLS, results from left and right legs are presented.

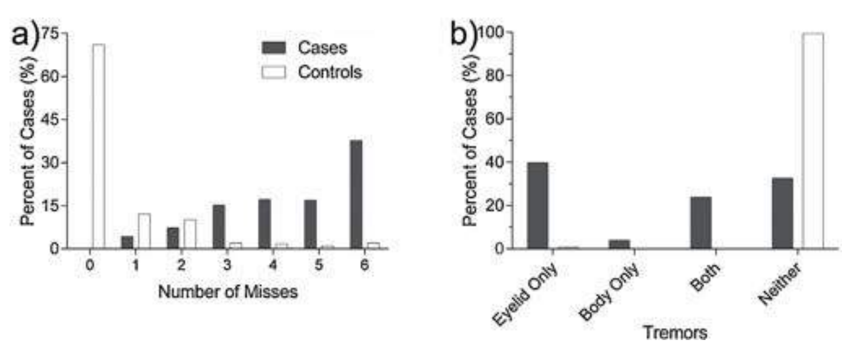

Fig. 4. Case (N = 302) and control (N = 302) frequency distribution of (a) misses (of 6 attempts), and (b) tremors observations on the Finger to Nose (FTN) test.

Of states where recreational cannabis is currently legal, Washington adopted a 5 μg/L per se cutoff (Armentano, 2013), and Colorado adopted a 5 μg/L "permissible inference" law (Colorado Revised Statutes, 2014; Urfer et al., 2014). We compared DRE results from cases with blood THC ≥5 μg/L to those with <5 μg/L. It was unsurprising that no significant differences were detected, due to the range of post-arrest blood collection times. Due to THC's pharmacokinetic profile, delaying blood collection may result in substantially lower concentrations than those present at the time of the traffic stop or crash (Biecheler et al., 2008; Desrosiers et al., 2014; Huestis, 2005; Huestis et al., 1992). Our DRE data illustrate this pattern: blood THC concentration was significantly and inversely correlated with blood collection time after arrest. To obtain the most accurate and reliable results, blood should be

Table 2
Evaluation of frequently detected signs or observations from the Drug Recognition Expert (DRE) evaluation in 302 cannabis-only driving cases and 302 non-impaired controls.

Sign/Condition/Observation	Percent of Cases (%)	Percent of Controls (%)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Efficiency (%)
≥2 Misses, FTN	94.4	16.6	94.4	83.4	85.1	93.7	88.9
≥3 Misses, FTN	87.1	6.6	87.1	93.4	92.9	87.9	90.2
≥4 Misses, FTN	71.9	4.6	71.9	95.4	93.9	77.2	83.6
Eyelid Tremors, MRB	86.1	6.0	86.1	94.0	93.5	87.1	90.0
Any Sway[a], MRB	78.5	11.0	78.5	89.0	87.8	80.5	83.7
Any Sway[b], OLS	85.8	7.6	85.8	92.4	91.8	86.6	89.1
≥2 Clues, OLS[c]	55.0	3.0	55.0	97.0	94.9	68.3	76.0
≥2 Clues, WAT	80.5	2.3	80.5	97.7	97.2	83.3	89.1
LOC	78.8	10.9	78.8	89.1	87.8	80.8	83.9
Bloodshot Eyes	77.5	3.1	77.5	96.9	96.3	80.7	87.1
Rebound Dilation	70.9	0	70.9	100	100	77.4	85.4
≥2 Clues, OLS[c] *and* ≥2 Clues, WAT	48.7	0	48.7	100	100	66.1	74.3
≥2 Clues, OLS[c] *or* ≥2 Clues, WAT	87.1	3.0	87.1	97.0	96.7	88.3	92.1
2/3 of: ≥3 Misses, FTN ≥2 Clues, OLS[c] ≥2 Clues, WAT	81.1	1.3	81.1	98.7	98.4	83.9	89.9
≥3 Misses, FTN *and* (≥2 Clues, OLS[c] *or* ≥2 Clues, WAT)	76.2	0.7	76.2	99.3	99.1	80.6	87.7
2/4 of: ≥3 Misses, FTN Eyelid Tremors, MRB ≥2 Clues, OLS[c] ≥2 Clues, WAT	97.0	3.3	**97.0**	**96.7**	**96.7**	**97.0**	**96.9**
3/4 of: ≥3 Misses, FTN Eyelid Tremors, MRB ≥2 Clues, OLS[c] ≥2 Clues, WAT	74.2	0	74.2	100	100	79.5	87.1
Rebound Dilation *or* LOC	92.7	10.9	92.7	89.1	89.5	92.4	90.9

Boldface indicates optimized combination of measures (best overall results, ≥96.7% on all diagnostic performance characteristics).
Abbreviations: Sensitivity (true positives [TP]/(TP + false negatives [FN])); Specificity (true negatives [TN]/(TN + false positives [FP])); PPV, positive predictive value (TP/(TP + FP)); NPV, negative predictive value (TN/(TN + FN)); Efficiency (TP + TN)/(TP + TN + FP + FN); MRB, Modified Romberg Balance test; LOC, lack of convergence; WAT, Walk and Turn test; OLS, One Leg Stand test; FTN, Finger to Nose test.
[a] Note: The MRB test does not have designated "clues"; sway represents a recorded observation.
[b] Note: Sway constitutes one of the four possible "clues" on the OLS test.
[c] ≥2 Clues on the OLS was considered true if ≥2 clues presented on at least one leg.

obtained as early as possible in the process of evaluating suspected impaired drivers. Although currently listed as the 12th step in the DRE evaluation procedure (International Association of Chiefs of Police, 2013a, 2015a, 2015b), it behooves officers to ensure blood is collected expediently, and the DECP training now allows for early collection of blood (International Association of Chiefs of Police, 2013a). The number of collections that occurred before the DRE examination in our study suggests that this message is disseminating, but still not yet ubiquitous. Early blood collection is challenging due to the requirement for a phlebotomist and/or a warrant to collect the blood, complicating the issue.

Eye examinations provided valuable data. HGN assessments are a regular part of clinical examinations by health care clinicians, evaluating integrity of the oculomotor system for irregularity or abnormality as signs of CNS impairment (Carlson and Kurtz, 2012 Ciuffreda and Tannen, 1995; Leigh and Zee, 2015; Rett, 2007). HGN in DRE evaluations likewise indicates impairment associated with select categories of drugs, e.g. alcohol, CNS depressants, dissociative anesthetics, inhalants, and/or medical conditions affecting driving ability, but is not typically associated with cannabis in these protocols (Couper and Logan, 2014; Kosnoski et al., 1998; McLane and Carroll, 1986; Richman and Jakobowski, 1994). Thus, the lack of significant HGN differences in our study was expected. VGN is associated with the same drugs that produce HGN [at higher doses] (Couper and Logan, 2014), but not cannabis. Our data suggest normal incidence of LOC in controls, consistent with overall ranges for convergence insufficiency (CI) in the general population (Scheiman et al., 2003), although no specific prevalence is known. However, LOC incidence in cases was 7-fold higher than controls. An underlying cause of CI is a connection between accommodative insufficiency (focusing) and convergence (Cooper et al., 2011). Focusing and adequate sustained attention to a task are essential components for absence of LOC. Cannabis produces dilated pupils, reduced focusing ability, and diminished attending abilities (Böcker et al., 2010), likely accounting for the increased LOC documented. Cases' pupils were consistently larger than controls' in all lighting conditions, indicating an overall cannabis dilation effect. Controls' pupil sizes in this study replicated an earlier study of unimpaired pupil sizes utilizing the DRE protocol (Richman et al., 2004), with no statistical difference in mean pupil sizes for any light condition between these studies. Besides acting as a marker for cannabis intake, pupil dilation influences safe driving. Dilated pupils can interfere with certain aspects of driving and vision performance (e.g., trouble seeing in light that is too bright), resulting in impaired daytime driving even without the presence of an impairing drug such as cannabis (Battistella et al., 2013; Wood et al., 2003). These negative effects would be further compounded by the psychomotor and cognitive effects of cannabis (Hartman and Huestis, 2013). Pupil responses to light such as rebound dilation ("pupillary escape") are influenced by initial pupil size (Sun and Stark, 1983). While small pupils are better regulators of light, dilated pupils more likely exhibit rebound dilation. This is consistent with our findings of overall pupil dilation and increased rebound dilation incidence in cases. Rebound dilation also was observed in a previous cannabis study (Fant et al., 1998), wherein final pupil diameter (diameter at the end of bright stimulus presentation) was significantly affected by cannabis.

This study has several limitations. Although the control population was negative by self-report for impairing drugs, were under observation of other police officers, and were participants in training/practice sessions, no toxicology results were available. Thus, controls may not have been 100% free of impairing substances; however, if this did occur, it would make it more difficult to identify differences between cases and controls. Additionally, the controls' demographic characteristics (age/race) were notably different from cases'—with median case age significantly younger (21 years) than that of controls (34 years)—and control evaluations only occurred during normal business hours (whereas case evaluations occurred at all hours). While cases had narratives available in addition to face sheets, controls did not, preventing certainty in FTN scoring. Another limitation to consider is that many (albeit not all) of the controls were police officers participating in DRE training sessions;

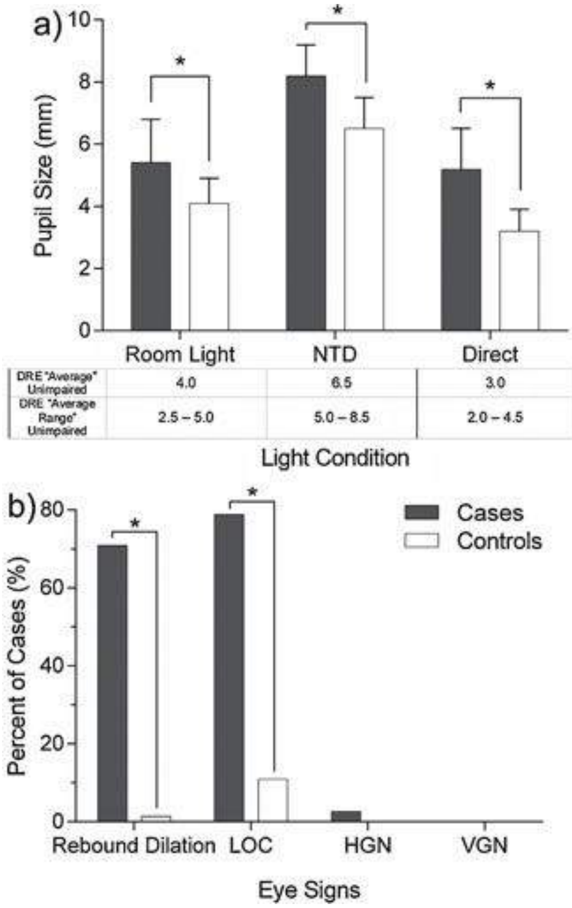

Fig. 5. Drug Recognition Expert (DRE) recorded eye signs for cannabis cases (N = 302) and controls (N = 302). (a) Mean (SD) pupil size measured in room light, near-total darkness (NTD), and direct light, with DRE-established "average ranges" for comparison. (b) Prevalence of rebound dilation, lack of convergence (LOC), horizontal gaze nystagmus (HGN), and vertical gaze nystagmus (VGN) detected. *$p < 0.001$, unpaired *t*-test.

thus, they were more knowledgeable and experienced with the divided attention tasks. Differences between the cases and the control group may have been greater than if a less experienced control group was included. It also is necessary to consider that cannabis represents only one of 7 drug categories evaluated by DREs. To fully elucidate a profile *specific* to cannabis, cases positive for other drug classes must also be evaluated and directly compared with cannabis-only cases, because several signs are exhibited in multiple drug classes. Finally, in this study all cases constituted correctly identified cannabis impairment by DREs in real-world evaluations. Our study design included only cases where the DRE identified cannabis impairment and toxicology supported cannabis intake. Thus, the diagnostic parameters (sensitivity, specificity, PPV, NPV, and efficiency) represent only those terms within the context of our study structure. Because there was selection bias in the positive "cases" (e.g., THC-positive cases where the DRE did not opine cannabis, and other erroneous DRE findings were not included), these parameters' results may be greater than if all cases were included. Additionally, evaluation of the *scientific* validity of the examinations is limited in this study design because DREs communicate with arresting officers and with suspects, thus knowing arrest conditions/observations (e.g., whether cannabis was present in vehicle or suspect was observed smoking) (Schechtman and Shinar, 2005). Thus, not all cases were identified purely by signs exhibited on psychomotor examinations, limiting our ability to identify psychomotor examinations that could definitively indicate cannabis impairment in the absence of other observations.

However, this also represents the greatest strength of the DECP. Psychophysical tests indicate impairment; other observations help distinguish cannabis as the causative agent. Certain signs and impairment characteristics may be observed for multiple drug classes (Cochems et al., 2007; International Association of Chiefs of Police, 2013a, 2015a, 2015b; Logan, 2009; Smith et al., 2002), and not all signs are detected in every case. The DECP is effective because it relies upon combined results from several examinations and observations, rather than any in isolation. Limiting DREs' observational information and interaction ability decreases effectiveness. When DREs evaluated 20 real cannabis-only cases (correctly identified by the original DRE) by relying solely upon recorded data, only 80.7% produced correct cannabis identifications (Smith et al., 2002). In an evaluation of DRE performance in a controlled-administration setting with multiple drug classes available, combining pulse rate, direct light pupil diameter, and reaction to light variables (without considering psychophysical results) produced 49% sensitivity and 77% specificity for cannabis impairment detection (Schechtman and Shinar, 2005). More elaborate combinations of 5 and 28 DRE variables resulted in 90.6% and 100% sensitivity, 92.6% and 98.1% specificity, and 91.9% and 98.8% efficiency for cannabis detection, respectively (Heishman et al., 1996). Our study corroborates previous evaluations (Heishman et al., 1996; Schechtman and Shinar, 2005) indicating that pupil size, rebound dilation, LOC, bloodshot eyes and elevated pulse may strengthen cannabis identification.

DECP impairment detection in cannabis cases was optimized by requiring impairment evidence in $\geq 2/4$ of the psychophysical tests, further illustrating the value of considering aggregate results from multiple sources. Papafotiou et al. (2005a) evaluated the sensitivity of the SFSTs to cannabis after placebo, 14 and 52 mg smoked THC, defined as "impaired" classification on at least 2 of the 3 SFSTs. Sensitivities were 23.1% and 41.0–46.2% (respectively) after the active doses within an hour post-intake, decreasing to 15.4% and 28.2% 1.75 h post-dose. Because HGN incidence after cannabis is negligible (International Association of Chiefs of Police, 2015a, 2015b; Porath-Waller and Beirness, 2014), it is more meaningful to compare the incidence of ≥ 2 clues on *both* OLS and WAT. This metric in our study compared favorably to previous data (Papafotiou et al., 2005a), occurring in 48.7% of cases and 0 controls. Importantly, the SFSTs differ from their respective DECP techniques; e.g., the OLS is only performed on one leg. Furthermore, although our study lacks controlled dosing and a within-subjects design, it retains real-world validity as these were actual cases involved in traffic stops (albeit not all moving violations) and determined to be impaired.

5. Conclusion

In 302 correctly identified cannabis-only DRE cases, the most reliable impairment indicators included elevated pulse, dilated pupils, LOC, rebound dilation, and documented impairment in 2 of 4 psychophysical tasks. Blood specimens for toxicology should be collected as early as possible, as measured concentrations are significantly related to collection time. No significant differences were detected in outcome measure prevalences between cases with <5 μg/L and ≥ 5 μg/L blood THC. Combined observations on psychophysical and eye exams produced the best indicators of cannabis impairment. The results of this research support the cannabis impairment training taught in the DECP.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.aap.2016.04.012.

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SCIENTIFIC PUBLICATIONS AND RESEARCH

REPORTS ADDRESSING NYSTAGMUS

1. Anderson, Schweitz & Snyder, Field Evaluation of Behavioral Test Battery for DWI, U.S. Dept. of Transportation Rep. No. DOT-HS-806-475 (1983) (field evaluation of the Standardized Field Sobriety Test battery (HGN, one-leg stand, and walk and turn) conducted by police officers from four jurisdictions indicated that the battery was approximately 80% effective in determining BAC above and below .10 percent).

2. Aschan, Different Types of Alcohol Nystagmus, 140 ACTA OTOLARYNGOL SUPP. 69 (Sweden 1958) ("From a medico-legal viewpoint, simultaneous recording of AGN (Alcohol Gaze Nystagmus) and PAN (positional alcoholic nystagmus) should be of value, since it will show in which phase the patient's blood alcohol curve is...").

3. Aschan & Bergstedt, Positional Alcoholic Nystagmus in Man Following Repeated Alcohol Doses, 80 ACTA OTOLARYNGOL SUPP. 330 (Sweden 1975) (abstract available on DIALOG, file 173: Embase 1975-79) (degree of intoxication influences both PAN I and PAN II).

4. Aschan, Bergstedt, Goldberg & Laurell, Positional Nystagmus in Man During and After Alcohol Intoxication, 17 Q.J. OF STUD. ON ALCOHOL, Sept. 1956, at 381. Study distinguishing two types of alcohol-induced nystagmus, PAN (positional alcoholic nystagmus) I and PAN II, found intensity of PAN I, with onset about one-half hour after alcohol ingestion, was proportional to amount of alcohol taken.

5. Baloh, Sharma, Moskowitz & Griffith, Effect of Alcohol and Marijuana on Eye Movements, 50 AVIAT. SPACE ENVIRON. MED., Jan 1979, at 18 (abstract available on DIALOG, file 153: Medline 1979-79) (smooth pursuit eye movement effects of alcohol overshadowed those of marijuana).

6. Barnes, The Effects of Ethyl Alcohol on Visual Pursuit and Suppression of the Vestibulo-Ocular Reflex, 406 ACTA OTOLARYNGOL SUPP. 161 (Sweden 1984) (ethyl alcohol disrupted visual pursuit eye movement by increasing number of nystagmic "catch-up saccades").

7. Burns & Moskowitz, Psychophysical Tests for DWI Arrest, U.S. Dept. of Transportation Rep. No. DOT-HS-802-424 (1977) (recommended the three-test battery developed by SCRI (one-leg stand, walk and turn, and HGN) to aid officers in discriminating BAC level).

8. Burns, The Robustness of the Horizontal Gaze Nystagmus (HGN) Test, U.S. Dept. of Transportation 2004. Concludes that HGN as used by law enforcement is a robust procedure and the data obtained in this report does not support changes or revisions to the current testing or procedure

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10. Citek, Ball and Rutledge, Nystagmus Testing in Intoxicated Individuals, Vol. 74, No. 11, Nov. 2003, Optometry, established that the HGN test administered in the standing, seated, and supine postures is able to discriminate impairment at criterion BAC's of 0.08% and 0.10%.

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12. Fregly, Bergstedt & Graybiel, Relationships Between Blood Alcohol, Positional Alcohol Nystagmus and Postural Equilibrium, 28 Q.J. OF STUD. ON ALCOHOL, March 1967, at 11, 17 (declines from baseline performance levels correlated with peak PAN I responses and peak blood alcohol levels).

13. Goldberg, Effects and After-Effects of Alcohol, Tranquilizers and Fatigue on Ocular Phenomena, ALCOHOL AND ROAD TRAFFIC 123 (1963) (of different types of nystagmus, alcohol gaze nystagmus is the most easily observed).

14. Helzer, Detection DUIs Through the Use of Nystagmus, LAW AND ORDER, Oct. 1984, at 93 (nystagmus is "a powerful tool for officers to use at roadside to determine BAC of stopped drivers...(O)fficers can learn to estimate BACs to within an average of 0.02 percent of chemical test readings." Id. at 94).

15. L.R. Erwin, DEFENSE OF DRUNK DRIVING CASES (3d ed. 1985) ("A strong correlation exists between the BAC and the angle of onset of (gaze) nystagmus." Id. at 8.15A(3).

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20. Norris, The Correlation of Angle of Onset of Nystagmus With Blood Alcohol Level: Report of a Field Trial, CALIF. ASS'N CRIMINALISTICS NEWSLETTER, June 1985, at 21 (The relationship between the

ingestion of alcohol and the inset of various kinds of nystagmus "appears to be well documented." Id. "While nystagmus appears to be useful as a roadside sobriety test, at this time, its use to predict a person's blood alcohol level does not appear to be warranted." Id. at 22).

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32. Wilkinson, Kime & Purnell, Alcohol and Human Eye Movement 97 BRAIN 785 (1974) (oral dose of ethyl alcohol impaired smooth pursuit eye movement of all human subjects).

33. Zyo, Medico-legal and Psychiatric Studies on the Alcohol Intoxicated Offender 30 JAPANESE J. OF LEGAL MED., No. 3, 1976, at 169 (abstract available on DIALOG, file 21: National Criminal Justice Reference Service 1972-85) (recommends use of nystagmus test to determine somatic and mental symptoms of alcohol intoxication as well as BAC).

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PAPER

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Horizontal Gaze Nystagmus: A Review of Vision Science and Application Issues

ABSTRACT: The Horizontal Gaze Nystagmus (HGN) test is one component of the Standardized Field Sobriety Test battery. This article reviews the literature on smooth pursuit eye movement and gaze nystagmus with a focus on normative responses, the influence of alcohol on these behaviors, and stimulus conditions similar to those used in the HGN sobriety test. Factors such as age, stimulus and background conditions, medical conditions, prescription medications, and psychiatric disorder were found to affect the smooth pursuit phase of HGN. Much less literature is available for gaze nystagmus, but onset of nystagmus may occur in some sober subjects at 45° or less. We conclude that HGN is limited by large variability in the underlying normative behavior, from methods and testing environments that are often poorly controlled, and from a lack of rigorous validation in laboratory settings.

KEYWORDS: forensic science, driving while intoxicated, DUI, sobriety testing, horizontal gaze nystagmus, DWI, HGN, driving under the influence, operating while intoxicated, OWI

The *Standardized Field Sobriety Tests* (SFSTs) have become an important part of driving while intoxicated (DWI) enforcement since they were introduced in the 1980s. Consisting of three standardized psychophysical tests, failure on the SFSTs is used to establish probable cause to arrest and demand a breath test. The defendant's performance on the SFSTs may also be introduced in most states as circumstantial evidence that the defendant is impaired by alcohol (1,2).

Of the three tests, *Horizontal Gaze Nystagmus* (HGN) has generated the most interest, both from scientific and legal perspectives. The other tests, Walk and Turn and One Leg Stand, arguably do not require any specialized knowledge to interpret, as many courts have held (1–4). Primarily, defendants are scored on behaviors that reflect lack of balance and coordination, symptoms of intoxication that have long been recognized. Legal tradition holds that any lay person can testify as to whether another person appeared intoxicated or not and that such judgments require no special expertise. In contrast, HGN's indications of intoxication are more subtle and not common knowledge. Further, HGN has roots in laboratory science and clinical medicine. For these reasons and others, HGN has often been regarded as a scientific test requiring expert testimony before admitting it as evidence. Although this might seem to require testimony from a behavioral or medical scientist, some courts have taken judicial notice of the test or permitted police officers to qualify as experts based on specialized training. Other courts do not deem HGN to be a scientific test (1–4).

HGN is controversial (5–8) and has been the subject of considerable advocacy by prosecutors and their experts and criticism by defense lawyers and their experts. Not surprisingly, there has been a polarization of opinion. At the time of this article, there have been no comprehensive scientific reviews of HGN from the perspective of eye movement science. This article will attempt to fill this void, focusing on laboratory studies of functional eye movement and gaze, including those that employed alcohol. It will not attempt to address physiology or diseases of the eye or nervous system in depth. We will begin with a brief description of the visual system and HGN. We will then address the empirical studies of HGN as a sobriety test, partisan arguments that support or criticize its use, and in the main part of the article, discuss empirical findings in the visual science literature that bear on its reliability and validity. Finally, we summarize our analysis and discuss the limitations of National Highway Traffic Safety Administration's (NHTSA) (1,2) training program for police officers and the implications for use of HGN in a law-enforcement environment.

Overview of the Visual System

The retina is the tissue at the back of the eye on which light is focused and detected. The most sensitive portion of the retina is the fovea, a specialized area that is densely packed with receptors and allows maximum resolution and clarity of images. Animals with a fovea must be able to move the eye to a target of interest, then maintain the gaze to keep the image on the fovea. People are able to change the direction of their gaze in several ways, some of which are reflexive and others which are mostly voluntary. The *smooth pursuit (SP) system* allows the viewer to smoothly track a steadily moving object, as long as it does not go too fast, thus keeping the image on the fovea. In this way, a motorist can read a road sign, even as it moves relative to the body and the rest of the visual field. Generally, the smooth pursuit system is reported to be able to track smoothly moving objects up to a rate of 30°/sec (9–11), although texts (12,13), a review (14), and authors of individual studies (15–19) report that wide individual differences exist.

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SP provides the means to maintain fixation on a moving target. In contrast, *saccades* are the primary means of changing eye fixation, either to a different object or to one that has moved too quickly or unpredictably to be followed by SP. Saccades are very rapid but require substantial preparation time to initiate—about 200 msec. Saccades are sometimes said to be "ballistic," in that once launched, they cannot be recalled. But once under way, they are fast—up to 1000°/sec—10 to 30 times as fast as smooth pursuit. Saccades take nearly twice as long to initiate as a smooth pursuit movement, and unlike SP, power is supplied in an explosive burst at the beginning of the movement. Given their respective characteristics, it is not surprising that the two systems often work in tandem: when the smooth pursuit cannot keep up, saccades take up the slack (12–14).

Not all visual targets move. Once the eyes find a stationary target, they must be maintained in the correct position. This requires the correct balance of muscle tone among the three pairs of opposing ocular muscles in each eye to resist the elastic forces connecting the eye in the orbit. Without continual input from *the neural integrator* (part of the oculomotor control center), the eyes cannot be held away from primary gaze (straight ahead). The neural integrator is brought into play for any smooth pursuit or gaze shift that takes the eyes away from the primary gaze position. Like the smooth pursuit circuits, it appears to be highly susceptive to anomalies in the nervous system, including the presence of alcohol. These result in a drift of the eyes off the intended target, followed by a saccade to bring the eye back on target. Together, these movements constitute *gaze nystagmus* (GN) (13).

There is another important means of orienting the eyes that is mainly reflexive. Whenever the head is moved rapidly, as when jerked by a heavy footstep, the eyes must rotate in the opposite direction to maintain fixation and clear vision. The vestibular ocular reflex (VOR) functions like the stabilization control on a video camera, allowing one to read a newspaper even if one shakes his/her head side to side. It does not require vision—it is controlled by the vestibular system of the inner ear and works on the sensation of motion. The VOR system is fast and able to compensate for abrupt movements remarkably well. VOR responses are influenced by alcohol, but the effects are only elicited through fairly rapid changes in head angle. Its reactions are accurate unless a stimulus is slow or sustained. In such situations, and if visual information is present, the optokinetic reflex (OKR) takes over. Unlike the VOR, OKR relies on visual input. Ideally, neither VOR nor OKR should come into play during roadside HGN, as the subject is directed to hold his head still and should be faced away from visual distractions, such as police strobe lights or passing traffic (1,2).

HGN

Description

To perform HGN, the police officer instructs the suspect to look at a stimulus, typically a pen, held 12–15 inches (30.5–38.1 cm) in front of the face and slightly above eye level. The subject is to keep the head still, following the stimulus using only the eyes. After two initial passes to ascertain that the eyes are tracking together and checking for equal pupil size (a screen for abnormal neurological or eye muscle conditions), the officer passes the stimulus from the center of the visual field to the officer's right (suspect's left) in a straight, smooth motion out to the maximum angle of gaze. The recommended speed is about 2 sec from the centerline to the periphery, or about 30°/sec (1,2). This motion is designed to assess breakdown of smooth pursuit, as manifested by the eyes falling behind the target and saccades to bring the eyes back to the target. Next, the officer is to hold the stimulus as far to the side as the subject can focus and look for *distinct* (large amplitude) and *sustained* (at least 4 sec) *nystagmus at maximum deviation* (DSNMD). Lastly, the officer returns the stimulus to the midline and slowly moves it laterally, at approximately 10°/sec, looking for onset of sustained gaze nystagmus before 45° of lateral deviation. In the most recent training materials, NHTSA instructs students to estimate 45° by moving the stimulus to the side a distance equal to the distance to the subject. A secondary guideline, which was the only one before 2006, is to move the stimulus to align with the tip of the shoulder. This approach will usually result in gross underestimation of 45° (20,21), although this works to the advantage of the suspect.

Each procedure is repeated once. The subject is scored one point for each of the "clues" described for each eye; the presence of four clues is taken as evidence of intoxication. There is no guidance about how to score a clue that is present during one of the two administrations. Students are taught that several medical conditions (brain tumors, brain damage, disease of the inner ear) may produce nystagmus but are told these are uncommon among suspects they will encounter. Environmental conditions (wind, dust, etc. irritating the suspect's eyes; visual distractions) are also noted as potential problems.

Prosecution and Defense Claims

There have been many claims about HGN from advocates and critics of HGN. In this section, we report some of them. The fact that an argument is cited should not be mistaken as indicating our support for that position.

The American Prosecutors Research Institute (22) asserted that HGN is the most reliable SFST and encouraged police officers to testify in support of this claim. HGN administration is said to be simple, including estimating 45° from the midline (23). Properly trained police officers are said to be able to distinguish HGN from other abnormalities of eye movement (24). One DWI Resource Prosecutor asserted that HGN signs are indicative of "visual dysfunction" (25), while another prosecutor asserted "HGN is not just an indicator of impairment; HGN is impairment" (26). Lastly, and unlike the other SFSTs, HGN has been touted as immune to practice effects (27–29).

In one of the first critiques by a defense attorney, Pangman (30) noted that the officer's scoring cannot be verified and could be altered after seeing the results of a portable breath test. He noted that unlike field applications, HGN laboratory studies employed protractors and chin rests, that there are a number of other recognized causes of nystagmus, and that lay persons may mistake normal saccades for nystagmus. He cited NHTSA sources which report that the angle of onset of nystagmus (AON) decreased after midnight in drinking subjects, and citing a respected medical source, claimed that "some 50–60 percent of all individuals exhibit gaze nystagmus indistinguishable from alcohol gaze nystagmus if they deviate their eyes more than 40° to the side" (30, p. 2). Defense attorney Mimi Coffey (31), citing prominent eye movement researchers, noted that there are over 40 recognized types of nystagmus and asserted it is unrealistic that a police officer can distinguish these forms from alcohol-induced nystagmus. In *State v. Dahood,* medical eye specialists opined that DSNMD occurs in as many as 80–90% of normal subjects, has no value as a sign of pathology, and should be eliminated from the HGN test (7). One ophthalmologist testified that HGN is invalid because the stimulus is held above eye level, thus involving muscles other than the lateral and medial rectus muscles that are primarily responsible for lateral eye movements (7). While NHTSA prescribes that each pass for breakdown of SP take 2 sec to go from midline to far gaze, for a speed of about 30°/sec, this same physician asserted that the limit of lateral eye movement is 85° and that the proper speed should be 20°/sec. Elsewhere he argued that a pass from midline to far gaze should take 4-sec (J. Citron, personal communication)—twice the NHTSA-recommended value. Rubenzer (8,32) pointed out HGN's lack of validity data pertaining to mental, physical, or driving impairment and noted that the interrater and test–retest reliabilities cited for HGN are inadequate by conventional standards.

Empirical Reliability and Validity

It is well established that moderate amounts of alcohol (e.g., 0.08% blood alcohol concentration [BAC]) result in breakdown of SP and increased nystagmus when the eyes are turned out away from primary position (12,13,33). However, HGN is a highly specific implementation of these principles and must be evaluated on its own merits as a sobriety test. There are numerous other causes of nystagmus other than alcohol (13,33), and the role of anxiety, fatigue, and environmental conditions in HGN performance has not been thoroughly examined.

Since their inception, HGN and the other NHTSA SFSTs have been validated against estimated BAC rather than indications of mental, physical, or driving impairment. However, HGN is not admissible to establish a precise BAC, or in most jurisdictions, even whether the defendant is above or below the legal standard (i.e., 0.08% BAC). Some jurisdictions have statutes that require specific biological tests, and there is concern over the lack of precision in estimating BAC and the fact that the officer's scoring cannot be verified (34).

HGN has been empirically evaluated in a number of laboratory and field studies. Substantial correlations with BAC are typically obtained (r_s = 0.51–0.77), as well as moderate levels of classification accuracy (8). However, none of the studies have been conducted in a truly blind manner. The laboratory studies excluded old or medically impaired subjects, were conducted during daylight hours, and did not invoke fear of arrest (7,8,32,35). Three large field studies, sponsored by NHTSA, reported high accuracy rates for the SFSTs and HGN (36–38). However, there are numerous limitations to these studies: Officers had the benefit of observing driving errors, the inside of the defendant's vehicle, and the defendant's demeanor. Stops appear to have been prompted by driving errors and circumstances (late weekend nights in close proximity to bars) that would constitute preselection of a high risk group. Not surprisingly, from 72 to 80% of those stopped were above the legal BAC limit. In two of the studies, officers were supervised in about half of the stops to ensure they performed the SFSTs correctly, and in the third, they had access to portable breath tests that may well have influenced their scoring. Lastly, in all three studies, officers were volunteers, experienced, highly motivated, and had just undergone refresher training. Thus, the accuracy rates reported for these studies may not be applicable to typical DWI stops (8,32) and should not be attributed to the field sobriety tests alone (39).

Rubenzer (8) reported that HGN clearly performed best among the SFSTs in studies such as those cited earlier, showing an average correlation with BAC of 0.65 across nine studies. Sensitivity to BACs above 0.08% or 0.10% was generally excellent (0.72–1.00) and specificity was usually good, although there were some clear exceptions. Likelihood ratios (an index of diagnostic power created by dividing sensitivity by the false-positive rate [FPR]) averaged 3.4–5.5 for BAC criteria of 0.04–0.10%, with better figures at 0.04%, although this was based on only two studies. These are respectable figures, but ones that are probably inflated by methodological problems in the studies. Variations in the speed or angle of administration for the smooth pursuit phase (i.e., horizontal vs. diagonal) do not appear to affect correlation with BAC (40), but the effects of such variations on diagnostic statistics were not examined. A recent study (41) found that false positives were not increased by variations from standard procedures, but false positives were unacceptably high (0.57–0.77) in all conditions. The position of the subject (standing, sitting, lying down) appears to have little effect (42–44), and administration of HGN on a boat provided positive results in two studies (45,46). Two unpublished studies found that HGN showed incremental validity over other observations (43) or field sobriety tests (45).

Diagnostic statistics such as sensitivity and FPR are potentially very informative, but when studies are not conducted blind or are otherwise flawed, their value is much reduced. In such circumstances, measures of reliability may be a better gauge of a test's functioning and potential. Both the interrater and test–retest reliability figures reported for HGN (r_s = 0.59–0.71) (23,42,46) are modest for tests that provide the basis for arrest and, often, evidence of impairment in legal proceedings. All figures are well below the 0.80 standard advocated by Heilbrum (47) and far below the "bare minimum" of 0.90 recommended by Nunnally and Bernstein (48).

Thus, and as delineated elsewhere (8,32), the limitations of HGN and its supporting literature from a behavioral science perspective include: (i) Minimal evidence that it is related to driving or behavioral impairment, (ii) lack of true double-blind studies to provide an unbiased estimate of its relation to BAC, (iii) interrater reliability below accepted standards, (iv) susceptibility to medical conditions and some medications (addressed in detail below), and (v) the prevalence of potentially confounding factors present at many DWI stops, including anxiety, fatigue, and circadian rhythms. Laboratory studies of eye movement functioning have addressed some of these issues and raised others.

HGN and Visual Science

This next section will discuss vision science findings relevant to HGN. There have been a great many studies of smooth pursuit, far fewer investigations of gaze nystagmus. Almost none refer specifically to DSNMD. This clue and the angle of onset of nystagmus will be discussed together, as they presumably share common mechanisms.

Smooth Pursuit

Description and Functional Parameters—When confronted with a target that begins to move at a moderate speed, the smooth pursuit system initially responds with a stereotyped movement of the eyes in the same direction as the movement of the object, but this brief, initial motion is not tailored to the target's velocity. The eyes then make a catch-up saccade to bring the image of the object onto the fovea (49) and begin the calibrated tracking of the object, generally matching its speed and direction (50). However, the match may not be precise, and saccades supplement the SP system to improve tracking performance (51). All six ocular muscles contribute to eye position in any direction (52,53), as they maintain tension at all times except when a saccade is made in the opposite direction of their angle of operation (54).

Eye researchers originally used pendulums to gauge SP, taking advantage of its natural sine wave motion. In the 1950s, electronics began to be used to present stimuli, and this allowed examination of a wide variety of stimulus parameters. While sine waveforms continue to be widely used, many researchers use constant velocity movements referred to as *ramps*, because a graph of the eyes' position by time results in a straight, sloping line to the right. *Triangle waves* refer to two ramp motions, one away from midline, the other back toward it, joined without a gap (see Fig. 1). Researchers will sometimes merge multiple sine wave patterns to create pseudorandom stimuli to reduce predictability of the motion. Some researchers recommend the use of ramp motions (55), others sinusoidal (56), and some stress the need for examination of both (13).

The maximum speed of smooth pursuit tracking varies greatly across people, stimulus conditions, and how smooth pursuit is defined. While some researchers have described the maximal speed of smooth pursuit as 30–45°/sec, others have argued for both lower and higher figures. One researcher noted that some subjects could not "keep up" at 20°/sec (57), whereas another reported a steady decline in the adequacy of SP throughout the range of speeds examined (1.7–20.8°/sec) (58). Others have argued that much higher values are possible (59–63). Perhaps as a result of practice or a superior nervous system, professional baseball players have been able to keep their eye on a fast pitch as it approaches the plate with an angular velocity of 90°/sec (59).

There are several ways of gauging the adequacy of SP, which contributes to the different maximum values claimed. The most prevalent index is *gain*, which is the ratio of the eye speed to that of the target. At low speeds, such as 10°/sec, gain will approach 1.00, as the eye can match the target degree by degree. At higher speeds, gain drops precipitously. Adequate smooth pursuit is typically represented by gains of 0.90 or above. Unfortunately, reporting practices vary across research groups, so that maximum tracking speed estimates provided are not comparable from one study to another. Some authors remove catch-up saccades from the eye tracing record and calculate gain on only the smooth pursuit movements, while others do not. This can make a substantial difference, because saccades are much faster than SP and occur when the SP system is falling behind. In one study, subjects were able to track a target at up to 90°/sec with saccades, but only 60°/sec without them (64). At the highest target speeds, no attempt is made to track the stimulus, and the eye remains in its original position (9). Two methodological issues deserve comment. High sensitivity recording equipment will detect saccades that are overlooked by lesser instruments, so researchers should report the resolution of their observations. Second, gain should be assessed only on the smooth pursuit portion of the record, after removing all saccades.

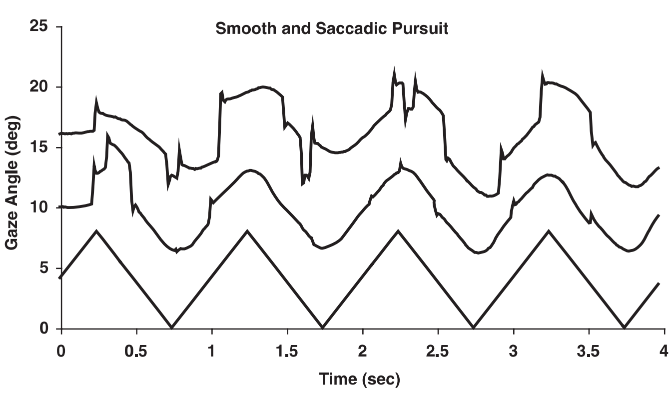

FIG. 1—*Example smooth pursuit traces. Eye (or target) position is plotted against time. Bottom trace shows the position of the target, a bright spot moving at 16°/sec to the right and then to the left, back and forth. Middle trace shows typical normal smooth pursuit for this situation with an initial large catch-up saccade at motion onset, followed by continuous smooth tracking with occasional small saccades superimposed. These small saccades would not be visible to the naked eye observing this tracking. Top trace shows attempt at smooth tracking when the target is intermittently illuminated. Frequent large saccades are made in place of smooth continuous following. This pattern of pursuit is found when either stimulus conditions or neurological/pharmacological conditions cause impaired pursuit tracking performance.*

A second method of gauging SP is to note the number and size of saccades the eyes makes in attempting to keep up with a fast target. One study suggested that this may be the most sensitive measure of SP performance (65), and unlike gain, it may be gauged without special equipment. Unfortunately, many authors do not report the size of saccades observed in the eye records, so it is unclear whether they would be visible without oculographic equipment, and their relevance to HGN is not clear. Other researchers, particularly in psychiatry, utilize a simple judgment rating scale (66) or the mean square deviation of the eyes' path from that of the stimulus. Such studies have reported impaired SP tracking in 6–8% of normal populations (67,68), but another study reported a figure of 20% (69).

Smooth pursuit movements are nearly always accompanied by saccades, although at low target speeds, they may be too small to detect without recording equipment (58). While many studies examined the speed of smooth pursuit, there is surprisingly little normative data available regarding the presence of nystagmus or presence of catch-up saccades for subjects at different ages and for different target speeds and stimulus conditions. However, several authors have reported findings that, if valid, would render the use of SP as a sobriety indicator problematic. Flom et al. (70) reported that above frequencies corresponding to 30°/sec, tracking movements were *entirely* saccadic. Moser et al. (71) reported observing 6.8 saccades per 20 sec of observation time in sober subjects, while figures increased to 9.8 and 12.5 for subjects at 0.05% and 0.10% BAC. Stimulus speed was 15°/sec, and all saccades were 1.5° or larger, but no further information is given. It is not clear whether saccades of 1.5° would be visible to a police officer at roadside, or scored if they were observed. Schalen (18) reported sizeable (3–10°) saccades occurred 6 times per minute at 10°/sec, with 11, 20, and 33 such saccades observed at 20, 30, and 40°/sec. Ross et al. (72) reported an average of 50.5 catch-up saccades per minute among a group of 37 normals, pursuing a target at 16.7°/sec. The average saccade was 2.5° (SD = 0.5), presumably large enough to be observed by the naked eye. However, in contrast to the previous findings, several authors have reported tracking at 30°/sec or more with few or no sizable saccades (11,73,74).

The smooth pursuit pass for HGN requires 2 sec per eye, or 4 sec to go from maximum deviation from one side to the other. Thus, to observe one such normal saccade during a typical 2-sec pass (one eye), a rate of 30 saccades per minute would be required, on the average, and this would produce two saccades during the pass across the whole visual field. Some studies have exceeded the 30 saccades per minute rate (70,72), but most have not (11,18,71,73,74). The actual rate of saccades per minute during HGN SP under the influence of alcohol has never been reported.

Age results in a decline in several aspects of smooth pursuit performance (12,75–80), possibly as a result of atrophy of cerebral cortical neurons or loss of cerebellar Purkinje cells. As people age, they react less quickly to the initial stimulus movement (78), show reduced gain, and require more catch-up saccades to track adequately (12,76–78,80). As one researcher stated, "the diagnosis of abnormal pursuit must be qualified by the age of the patient.

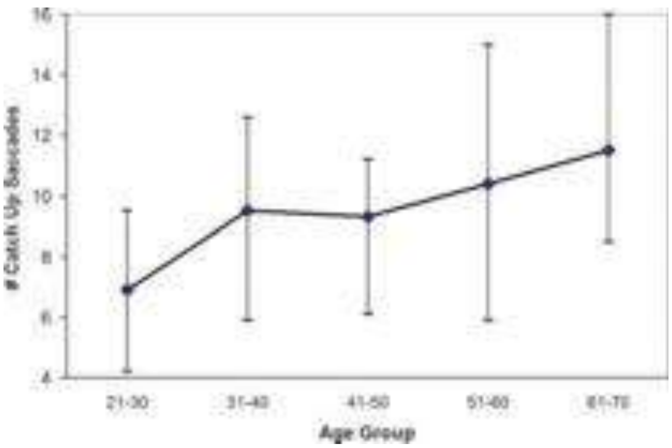

FIG. 2—*Quality of smooth pursuit (SP) as a Function of Age, adapted from Chan et al. (76). Error bars reflect one standard deviation of scores (about 84% of cases) within an age group. Note the large degree of individual variation within age groups, and the substantial increase in catch-up saccades beginning in the 31–40 age group.*

Smooth pursuit is an age-dependent motor system" ([80], p. 465). While younger subjects are able to maintain gains of over 0.90 to targets moving 30–40°/sec, the gain for elderly subjects fell below 0.90 when targets exceeded 5°/sec in one study (80). A significant decline in maximum gain may occur as early as after age 30 ([76]; see Fig. 2). There is some evidence that women, particularly older women, perform less well than men the same age (77).

Qualities of the target also influence SP. Bright targets elicit greater eye acceleration, at shorter latencies, than do dim targets (13). If ambient light is poor, parafoveal tracking may be preferred, at which time rods are more efficient photoreceptors than cones (13). Thus, quality of illumination may be important, and police officers might be advised to use a light-emitting (but nonaversive) stimulus during night-time DWI investigations. Maximum velocity for nasal-ward eye movement is typically higher than for movements toward the temple (51), and higher for targets at the center of the visual field than for eccentric targets (11). Smooth pursuit is relatively robust to stroboscopic (intermittent) illumination (81,82), but blinking causes a brief reduction in eye speed, followed by a catch-up saccade. Blinking causes the contraction of all the eye muscles, and the disruption to SP may be the result of a central process (decreased activity in omnipause neurons) rather than vision loss during the eye closure (83). The predictability of a target's motion also greatly influences the accuracy of smooth pursuit, so that a steady velocity of stimulus movement is important (13). Time to change from one speed to another unanticipated speed requires about 133 msec (49), and such a change often generates a small saccade (10). It should be noted that these studies utilized mechanical or electronic presentation of stimuli that could change speed instantaneously, which presumably would not be the case for a human administrator.

The role of attention in smooth pursuit performance is complex and not fully understood, in large degree because pursuit movements are a combination of voluntary (SP) and reflexive (OKR) responses to target motion. Some researchers use the term "smooth pursuit" to describe the putative mechanisms of voluntary tracking, while others use the term to describe the behavior of following a small target. Deficits in nonvoluntary attention have been proposed as the reason for the deficits observed in schizophrenia and attention deficit disorder (ADD), and attention areas of parietal lobe are implicated in target selection for pursuit. However, smooth following eye movements also involve a visual reflex, dependent primarily on a relatively simple cortico-pontine-cerebellar pathway, linking visual sensory areas involved in the processing of motion signals to motor regions of the cerebellum, via the pontine nuclei (84).

Because SP has been conceptualized by some as an automatic process, it has been theorized that distracter tasks will draw attention away from SP, allowing it to function unencumbered by disruptive intentional processes. Results have been decidedly mixed. Some distractions have been observed to increase blinking, saccadic intrusions, and "velocity arrests" (disruption of SP) in some studies (85–88), but to improve smooth pursuit in others (89–91). Barnes and Crombie (92, p. 550) reported SP was "heavily influenced by the presence of any unintended static peripheral cues, hence the need to operate in conditions of complete blackout." On the other hand, when the subject is required to pay attention to a quality of the stimulus (i.e., changes in color), SP is enhanced (93), as it is with larger or high contrast stimuli (13). And while HGN might seem a largely nonverbal task, the instructions subjects are given influence the quality of tracking (18). Several researchers have commented on the need to prompt older or fatigued subjects to pay close attention and try hard to obtain optimal results.

The presence of a patterned background, or competing stimulus, tends to lower the gain of smooth pursuit by about 10–20%, particularly if the background contains sharp visual boundaries perpendicular to the direction of eye movement or meaningful background images (58,94,95). Disruption is the greatest for distracting material in the same visual plane, less so for material behind or in front of the stimulus (96). Interference appears to be greater when the target is toward the periphery (92,94,97,98). If the background moves in the opposite direction of the target, interference is increased; if it moves in the same direction, SP may be facilitated (95,98).

Fatigue is sometimes represented as a cause of diminished SP, although often without supportive references or ones that fail to support the assertion (12,15,99). Barnes and Crombie (92, p. 550) stated that the nystagmus they observed was "susceptible to changes in arousal, responses diminishing with increased drowsiness," but presented no quantitative data. Another study examined a single subject after 30 h without sleep and reported that tracking was almost entirely saccadic (15). Subjects showed 10% fewer saccades in the morning than in the afternoon in another investigation (100). An unpublished study reported that 24 h of wakefulness did not affect smooth pursuit in HGN (101). However, two published studies (102,103) reported degradation in smooth pursuit after substantial sleep deprivation (40 h in one), but little loss of performance until sleep loss exceeded 24 h or subjects reported high levels of sleepiness. It should be noted that there are several possible types of fatigue: muscle, mood state, and fatigue that is often presumed by time of day, time without sleep, or amount of previous activity. While it is unlikely that muscle fatigue plays a role in HGN, the others may be relevant.

One of the claimed benefits of HGN is resistance to training or practice. Some studies have found no effect of retesting SP in schizophrenic or psychotic patients (104,105), but others have reported a powerful effect of active training or biofeedback (12,106,107). None has examined the ability to suppress nystagmus under the influence of alcohol, however.

Thus far, we have only discussed SP in terms of drift and catch-up saccades. However, a number of researchers have described other types of saccades that may supplement, or interfere with, SP. *Leading* or *anticipatory saccades* take the eye ahead of the moving target and may reflect a loss of crucial inhibitory control. Some have suggested that the saccades produced by normals in SP tasks are not catch-up saccades, but leading ones (88), whereas many researchers do not distinguish among various types. One study that did distinguish them found the most fast eye movements were not catch-up saccades but were in the direction of target travel (100).

Physiology and Effects of Medical Conditions and Drugs—A substantial number of brain centers control smooth pursuit. These include the neural integrator, a group of structures located in the nucleus prepositus hypoglossi. Situated in the lower brainstem, the neural integrator coordinates the velocity and position changes required for all conjugate (paired) eye movements. Other subcortical structures that support horizontal SP include the Dorsolateral Pontine Nucleus, the brainstem, and the cerebellum. Cortical areas include primary visual areas of the occipital lobe, motor areas in the Frontal Eye Fields, motion processing areas in the Middle Temporal and Medial Superior Temporal areas, and the V1 and attention-related areas of the occipital lobe (84).

Many medical conditions affect SP, including Parkinson's disease, progressive supranuclear palsy, cerebellar disorders, hepatic encephalopathy, Alzheimer's disease, and large cerebral lesions (13). Hartje et al. (108) reported that patients with lesions (vascular, neoplastic) in one brain hemisphere or diffuse brain damage (traumatic, inflammatory, degenerative diseases, epileptics) showed many large saccades during smooth pursuit. None of these patients had evidence of cerebellar or brainstem dysfunction, indicating cortical damage was sufficient to disrupt SP. Another group of researchers (109) found 76% of patients with a confirmed diagnosis of multiple sclerosis, and 25% of patients with optic neuritis, showed impaired smooth pursuit, which manifested as greatly increased number of saccades to stimuli moving more than 35°/sec. Abnormal SP was found in 46% of patients with generalized vascular disease (long-standing hypertension, diabetic vasculopathy, arteriosclerosis), 69% of 32 patients with localized eye disorders (cataract, glaucoma, scleritis, optic atrophy, leukoma, contusion of the globe, retinal aneurism or detachment), and 73% of 325 patients with the diseases of the central nervous system such as Parkinson's disease and Alzheimer's dementia (74). Citek (110) reported that hypoglycemia will produce disruption of SP, but no other eye symptoms. Aside from neurological or muscular dysfunction, physical obstructions, such as a tumor in the eye socket, can impair smooth pursuit. In Brown's syndrome, the action of the superior oblique muscle is limited by a restriction in the orbit or by resistance at the point where its tendon passes through the trochlea. Barbiturates and other depressants impair SP, as do medications used to treat pain, seizures, agitation, mood swings, anxiety, and insomnia (see Table 1), several of which are common conditions. An extensive list of factors that may potentially produce nystagmus has been articulated in court cases such as *Schultz v. State* (111), but this list is not complete and a number of the causes cited have not been demonstrated to cause eye movement abnormalities.

Some psychiatric disorders also affect SP. The first such study noted a parallel between eye behavior and psychiatric symptomology: Manics had a tendency to overshoot the target when making corrective saccades, whereas depressives showed "overdamped" responses (112). This and many studies have reported low gain and smooth pursuit interrupted by saccades in schizophrenics and their first degree relatives (68,113,114), but the degree of psychosis, rather than diagnosis, appears to be the strongest predictor of poor SP (66,68). Findings for patients with bipolar disorder (manic depression) have been mixed (66,115). About 50% of acutely ill manic patients show impaired smooth pursuit, while impairment in

TABLE 1—*Drugs other than alcohol that impair smooth pursuit or cause gaze nystagmus.*

Chemical Class or Name	Common Trade Names	Street Names	Use	Effects
Benzodiazepines	Xanax, Valium, Ativan, Klonopin, Restoril, Serax, Rohypnol, Halcion, Librium, Dalmane, Mogadon. Ambien	Downers, Tranks, Blues, Yellows	Treatment of anxiety, muscle spasms insomnia, agitation, seizures	SP
Phenytoin	Dilantin, Phenytek	NA	Treatment of seizures	SP, GN
Carbamazepine	Tegretol, Biston, Calepsin, Carbatrol, Epitol, Equetro, Finlepsin, Sirtal, Stazepine, Telesmin, Timonil	NA	Treatment of mood swings, bipolar disorder, seizures	SP, GN
Barbiturates	Phenobarbital, Seconal, Amitryl	Barbs, Downers, Reds, goofballs, Yellow Jackets, Blue Devils	Treatment of agitation, pain, anxiety	SP, GN
Lithium carbonate	Carbolith, Cibalith-S, Duralith, Eskalith, Lithane, Lithizine, Lithobid, Lithonate, Lithotabs	–	Treatment of bipolar disorder, mood swings	SP. GN
Nicotine	NA	–	Recreational	SP*
Narcotics	Morphine, Codeine, Dilaulid, Percodan	M, Morph, smack, junk, horse	Treatment of pain	SP
Choral hydrate	Noctec	"Mickey Finn"	Produce sleep	SP
Nitrous oxide	NA	Buzz Bomb	Calm patients, analgesia,	SP
Phencyclidine	NA	PCP, wet, fry, angel dust	Animal tranquilizer	GN†

Adapted from Leigh and Zee (13), Table 12–11.
SP, smooth pursuit; GN, gaze nystagmus.
*Causes square wave jerks; its effects on SP are variable.
†Causes nystagmus even at primary position.

such patients in remission may be because of lithium treatment (115). Studies have found disrupted SP in schizotypal patients and in subjects deemed "at risk" for schizophrenia (67,105,116). A mixed group of "26 neurotics undergoing therapy" showed larger and much more frequent saccades than did the normal control group, although considerably less than the neurologically impaired sample (108). Abnormal SP has been found associated with self-report depression scores (114), but not elevated neuroticism scores (116) or experimentally induced stress/anxiety (90). Children with ADD show reduced smooth pursuit efficiency and saccadic intrusions, although the only study to examine ADD in adults did not find significant impairment in most subjects (72). Lastly, 42.4% of chronic alcoholics were found to have impaired smooth pursuit, marked by prominent saccadic movements, compared to 20.0% of age-matched controls (69).

There is some evidence that stimulant drugs can lessen SP impairment in affected populations. Nicotine tends to improve SP in schizophrenics (117,118), and Ritalin did so in one study of ADD children (119), but not another (120). Thus, it is possible that the use of common stimulant drugs in combination with alcohol may mask breakdown of SP and pose a substantial challenge to law-enforcement use of HGN.

Nicotine is one such drug, and its effects are complex. It is associated with a peculiar pattern of movement called *bow tie nystagmus*, named for the shape the eye movement takes. The movement was produced at primary position in the dark and disappeared when the subject fixated on a target (121) and thus is not likely to be confused with HGN. Another study reported that smoking produced various forms of nystagmus in 16 of 25 subjects, apparently at primary position (122). Smoking a single cigarette has been reported to impair SP (123), and nicotine ingestion can lead to an increase in *square wave jerks* ([123,124]; see Fig. 3), a pattern of saccades that could easily be mistaken for alcohol-induced nystagmus. Several other authors reported no effect of nicotine in normals (vs. schizophrenics) (117,125,126), and two studies reported that nicotine improved SP slightly, albeit in only one eye (118,127).

Reliability—The *test–retest* reliability of SP measures has been thoroughly examined in schizophrenics and found to be adequate for research purposes, but only a few studies have addressed performance in normals or drinkers. Ettinger et al. (128), using gain and frequency of saccades as dependent variables, found good retest reliability for SP at 36 and 48°/sec among sober subjects, but not for movements at 12 and 24°/sec. Use of catch-up saccades as a dependent measure yielded lower reliabilities than for gain. Using a criterion of interclass correlation (ICC) > 0.40 as indicative of good reliability,[1] all values met this standard except for gain at 12 and 24°/sec and catch-up saccades at 12°/sec. The ICC value for gain at 36°/sec exceeded the cited 0.75 standard for excellent reliability. Cronbach's alpha (used to assess internal consistency) was above 0.75 for all variables except for catch-up saccades at 12°/sec (see Table 2). It was not reported whether the reliability differences across conditions were statistically significant. Another set of researchers (129) also found test–retest reliabilities were somewhat better for faster moving stimuli and somewhat better for retesting immediately ($r = 0.73$) or after 2 weeks ($r = 0.77$) than after 2 years ($r = 0.65$).

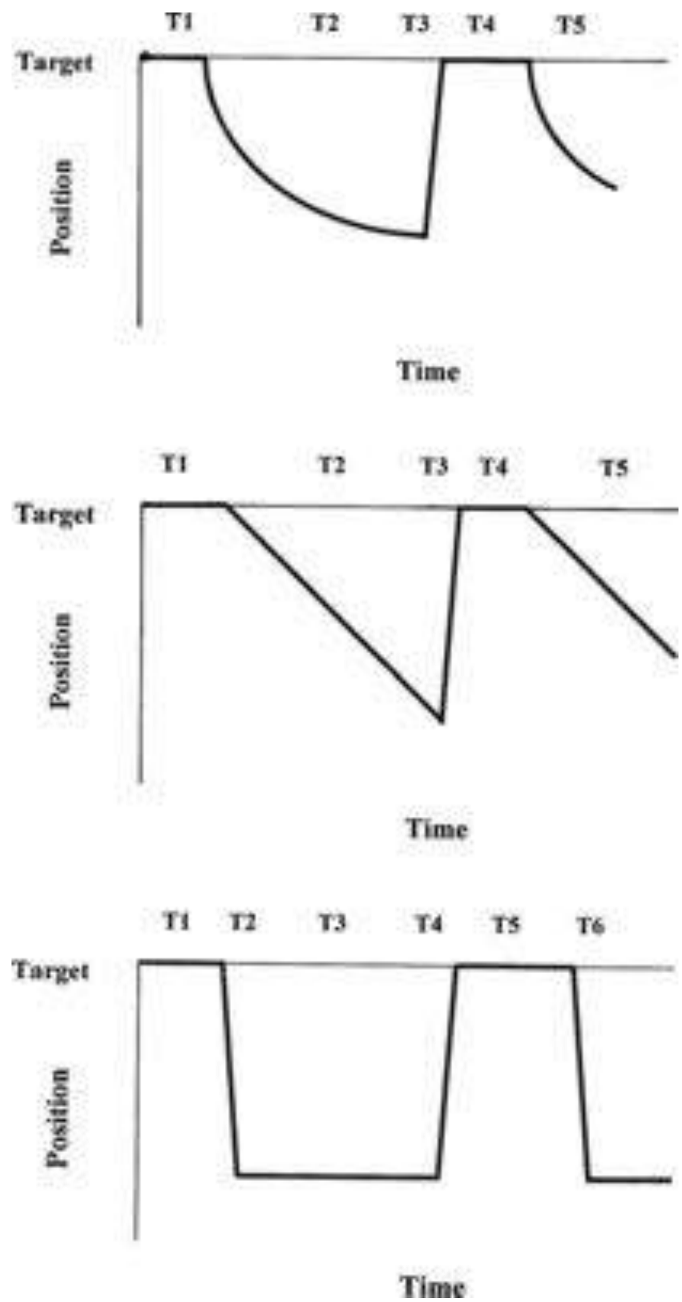

FIG. 3—*Schematic representations of alcohol gaze nystagmus, vestibular nystagmus, and square wave jerks. The top drawing shows the type of gaze nystagmus expected from alcohol. At first, the eye is fixated on the target (T1). It then begins to fall away from the target (T2) back toward the center of the visual field, fast at first, then more slowly. Finally, the drift stops and a saccade is made to bring the eye back to the target (T3). The eye remains briefly at this position, on target (T4), and the cycle then repeats (T5). The middle drawing depicts a vestibular-based nystagmus. The eye briefly fixates on the target (T1) but is then driven away by the neural signal (T2), showing a constant velocity. At T3, a saccade is made to bring the eye back to the target, where it remains but briefly (T4). The cycle then begins to repeat (T5). The bottom schematic illustrates a square wave jerk. Initially (T1), the eye focuses on the target. It then makes a saccade away from the target (T2), rests for a fraction of a second (T3), then makes a saccade back to the target (T4). The pattern then may repeat (T5).*

However, the usual meaning of test–retest and internal measures of reliability may be inverted in the case of SP used as a sobriety test. Because all subjects should perform quite well when sober, with few saccadic intrusions, there should be few reliable

[1]Interclass correlations take account of difference in mean value as well as rank order, and thus tend to be smaller than Pearson's r calculated on the same data. Nonetheless, the ICC figure of 0.40 seems less stringent than the 0.80–0.90 standard for reliability cited by authorities.

TABLE 2—*Test–retest and internal consistency reliability figures for smooth pursuit and fixation variables from Ettinger et al. 2003.*

Variable	Baseline Value	Pearson's *r*	ICC	Cronbach's Alpha
SP gain 12°/sec	98.6	0.11	0.10	0.83
SP gain 24°/sec	95.3	0.31	0.31	0.85
SP gain 36°/sec	89.6	0.81	0.77	0.85
SP gain 48°/sec	71.9	0.71	0.70	0.88
CUS 12°/sec	0.29	0.42	0.34	0.34
CUS 24°/sec	1.01	0.64	0.59	0.76
CUS 36°/sec	1.84	0.60	0.58	0.85
CUS 48°/sec	2.37	0.59	0.58	0.82
Fixation (# saccades/sec)	0.01	0.55	0.54	0.45

CUS, catch-up saccade; ICC, interclass correlation; SP, smooth pursuit.

TABLE 3—*Mean scores and test–retest correlations from Mundt et al., 1997.*

		Test–Retest Reliabilities		
Measure	Base Line Mean	Baseline-Baseline	Alcohol-Alcohol	Baseline-Alcohol
HGN	0.2	NS	0.45	NS
GN	0.6*	0.55	0.55	0.45
SP 20°/sec	7.9†	0.35	0.64	0.56
SP 40°/sec	13.7†	0.35	0.65	0.51

Base line mean scores for standardized field sobriety tests (SFSTs) are raw scores for each respective test.

HGN, horizontal gaze nystagmus; GN, gaze nystagmus; SP, smooth pursuit.

*Metric is the standard deviation (error) of the eye position, in degrees.

†Metric is formed by multiplying the number and average size of saccades.

differences between individuals or trials, and this is reflected by low reliability figures.[2] Conversely, reliable individual differences were present for the higher stimulus of 36°/sec or faster, indicating that stimulus speed is a critical variable in correct performance of HGN. The reliability paradox does not apply to interrater reliability (which Ettinger et al. did not examine), as agreement among qualified observers is essential, at least for within the parameters (e.g., stimulus speed) that HGN is likely to be performed.

Mundt et al. (130) did not observe Ettinger et al.'s pattern of results, finding low test–retest reliability whether sober subjects were presented targets at either 20 or 40°/sec ($r = 0.35$). The dependent variable was number of saccades multiplied by their size. Test–retest correlations when subjects were dosed to 0.08% BAC were 0.64 and 0.65, but scores when not drinking were strong predictors of performance when drinking ($r_s = 0.51$–0.56; see Table 3). There was a considerably greater increase in error scores (from sober to dosed condition) for pursuit at 20°/sec than for 40°/sec (not shown in table), probably because the higher speed generated saccades in more people in the sober condition.

Interrater reliability of SP has rarely been assessed outside of the HGN literature. One study reported figures from 0.85 to 0.99 in a study utilizing software (117), and several others reported correlations between raters of 0.86–0.89 when viewing eye movement traces (66,67). We could find no data on the reliability of SP observations unaided by oculographic instruments.

Influence of alcohol—A number of researchers have reported that SP impairment begins by 0.05% BAC (71,131–138), although the amount of impairment at this level may be minimal (131) and in one study, SP deficits had largely disappeared as BAC fell to 0.047% several hours after drinking (16). Several groups have reported that the degree of SP impairment increases from lower to higher BAC levels (70,71,131–134). Flom et al. (70) reported that breakdown of SP began at 0.02% and increased steadily through 0.12%. Another group (135) reported significant decrements in SP at 0.03% BAC. Wilkinson et al.'s (134) charts indicate the substantial impairment of SP at 5 min after the consumption of alcohol, at which time BAC was only about 0.015%. No studies were located that reported normal SP at BACs > 0.05% BAC.

Gaze Nystagmus

The natural resting position of the eyeball in a normal, awake individual is facing straight ahead, called primary gaze. Large deviations from primary gaze are unusual in daily life, as people naturally turn their head to fixate on or follow targets that are more than 15–20° off the midline (13). To look to the side, as required in the HGN test, the oculomotor system must overcome the substantial elastic, restorative forces of the muscles and connective tissues that support the globe. This requires a finely calibrated and very steady source of nerve innervation under control of the neural integrator. A "leaky integrator" is unable to maintain steady eye control, causing the eye to drift back toward primary gaze and resulting in gaze nystagmus. The effort required to maintain gaze away from the midline increases in direct proportion to the angle of deviation, 1.2 g/degree (49). Alexander's law, originally applied to vestibular-induced nystagmus, holds that the amplitude of nystagmus increases as the angle of deviation is increased (13,137). Thus, the HGN clue of DSNMD appears closely related to angle of onset of nystagmus (AON) and perhaps redundant with it.

In HGN, the clues of DSNMD and onset of nystagmus before 45° rely on eliciting nystagmus as the eyes are turned away from the midline. Readers should be aware that terminology can be confusing in this area. A number of researchers refer to "endpoint nystagmus" but are not referring to nystagmus at maximum deviation as one might expect. Rather, it simply means nystagmus when the eyes are deviated to the side, sometimes as little as 25°.

Although an authoritative text (13) stated that the gaze fixation system is relatively robust to changes in target size, luminance, color, and distance, no references were cited in support of this conclusion. While many parameters for SP have been investigated, GN has received relatively little attention. In the following section, we will discuss the few findings available regarding possible confounding factors before moving on to detailed discussions of normative studies, reliability, and the effects of alcohol.

Many medical conditions and medication, as discussed previously, can cause nystagmus during either smooth pursuit or lateral gaze (see Table 1). There is very little literature on the effect of psychiatric disorders on gaze steadiness. One study found adult ADD patients had difficulty maintaining fixation, often making inappropriate saccades off-target (138), while results for persons at risk for schizophrenia are mixed (105,139).

Several unpublished studies found no effect of circadian rhythms or fatigue on gaze nystagmus in subjects who are not drinking (23,101,140), although alcohol (0.10% BAC) decreased the angle of onset of nystagmus after midnight in two of them. However, one was based on only five subjects and the other ten, five that may have been subjects in the first. In contrast, the only peer-reviewed study (141) reported that 55% of subjects showed DSNMD in one or both eyes after sleep deprivation of 24.5 h and 13–14 h of continuous mental and physical activity.

[2]One of the paper's reviewers deserves credit for this interpretation.

The prevalence of gaze nystagmus in normal groups has been examined by several groups. The HGN developers (23) reported that 50–60% of individuals show some small, transient nystagmus at maximum deviation, a figure congruent with at least one medical source (142), but Booker (141) reported 19% of sober subjects showed DSNMD in one or both eyes. Coates (143) declared that the angle of onset of nystagmus (AON) in normal population is 40–45° but did not cite any data or references. A series of studies of 115 normal subjects (144) found that no subject had onset of nystagmus at 40° or less of lateral deviation, and a subsequent investigation led the authors to conclude that nystagmus at <40° should be viewed as a sign of a disturbed equilibrium in the oculomotor system. This conclusion was seconded in another large study (145), which found the average AON was 52.25° in both eyes, with a standard deviation of 6.5°. However, examination of the data (see Table 4) shows nearly 10% of subjects showed AON at <45°, and an additional 9.2–14.5% showed AON at this point. Sixty-three percent of 260 subjects showed some nystagmus at maximum deviation; 13.5 percent of these showed nystagmus in only one eye. Most surprisingly, older subjects showed less nystagmus at maximum deviation than younger subjects. Several other studies that examined gaze nystagmus (146–148) used much smaller samples. Schmidt and Kommerell (148) reported that some of six subjects displayed onset of nystagmus at 45–50° of lateral deviation within a few seconds, and all did with enough time. Further, the amplitude of nystagmus was large and persistent—possibly large enough to qualify as DSNMD. With the exception of Booker, none of the earlier mentioned studies examined the presence of DSNMD in sober subjects, and we were unable to find any empirical work that reported such findings.

The maximum angle of eye deviation from the midline varies among subjects, with average figures of 55–59° for age groups up through 50 (149,150), and a standard deviation of about 6° (149). Each eye is able to gaze 2–5° further to its own side (abduction) than across the midline (adduction). Older subjects show reduced maximum range, both toward and away from the midline (149,150).

Only one study has examined the concordance of SP deficits and gaze nystagmus. From an original sample of 623 patients with one or both deficits, 52 patients were selected based on several exclusion criteria. The authors reported that "a substantial gaze-evoked nystagmus of more than 3–4°/sec at 40° lateral gaze is *always* [italics added] combined with a SP deficit" ([151], p. 387). Twenty-five percent of subjects had SP deficient without gaze nystagmus. The authors noted that the neural integrator is essential for all conjugate eye movements, while lesions to cortex, brain stem, and cerebellum can disrupt SP without impairing gaze holding.

Reliability—Reliability of gaze nystagmus measures was examined by the same two research groups that provided such data for SP. Ettinger et al. (128) examined gaze stability at primary position and at 12° left and right gaze in sober subjects. Both internal and test–retest reliabilities were low (r_s = 0.45 and 0.55, ICC = 0.54). However, the relevance of these figures to HGN is unclear. When fixation stability is used as a sobriety test, large angles (30–65°) of eccentric gaze are utilized, resulting in substantial effort to maintain gaze well outside its natural range. Further, Ettinger et al.'s subjects did not consume alcohol, and as explained previously, low test–retest reliabilities may be desirable. Mundt et al. (130) examined the number and size of saccades when sober and drinking subjects were asked to focus on targets at 35, 40, and 45° eccentric. The test–retest correlation for subjects tested and retested sober was 0.55, as it was for subjects tested and re-tested at *c.* 0.08% BAC. Sober performance predicted performance when dosed with alcohol (r = 0.45). No studies have directly examined any of the various types of reliability (internal, test–retest, interrater) specifically for DSNMD or AON (as opposed to generalized gaze nystagmus) following consumption of alcohol.

TABLE 4—*Angle of onset of nystagmus in 131 subjects.*

Angle from Midline	Percent of Subjects Showing Nystagmus: Left (%)	Right (%)
35	0.8	0.0
40	9.2	9.2
45	9.2	14.5
50	33.6	28.2
55	27.5	25.2
60	16.0	17.6
65	3.8	2.3
70	0.0	3.1

Effects of alcohol—In the seminal study on gaze nystagmus and alcohol, Aschan (152) reported that most subjects showed the onset of gaze nystagmus at 40° lateral gaze for 0.06% BAC. While subjects tended to show the same thresholds for the ascending and descending limb of the BAC curves, there was substantial intersubject variation. Aschan noted that gaze nystagmus increased in intensity with increased eccentric fixation, consistent with Alexander's law, and appeared at smaller angles when one eye was covered.

Only one study has examined the HGN clue of the onset of nystagmus before 45°. Burns et al. (personal communication, 2000) attempted to identify the BAC threshold from this clue using laboratory equipment and blind testing procedures. All subjects above 0.08% BAC were accurately classified, whereas three of nine subjects that averaged 0.06% BAC were misclassified.

Unlike the other HGN clues, DSNMD was introduced in the second SFST laboratory study (23) without explanation or references. The only empirical study located that directly evaluated this HGN clue found reason for caution in its use. Booker (141) did not report diagnostic statistics for subjects while intoxicated, but reported that 62% of subjects continued to show DSNMD in at least one eye immediately after all alcohol had cleared from the blood. Only one rater participated, so interrater reliability could not be examined.

Several studies reported that AON correlated with BAC 0.70 or more using basic instruments (23,153,154). NHTSA researchers (23) examined this variable, but for field use recommended a dichotomous rating of whether or not the AON was <45° or not. However, according to their data, this decision point yields an estimated BAC of about 0.06%. Officers were directed to estimate this angle by alignment with the shoulder, as the researchers apparently deemed the use of a cardboard protractor as too cumbersome in the field. However, the correlation of the officers' estimates with the actual angle was only 0.58. When a continuous AON was measured mechanically, it achieved a correlation of −0.71 to −0.72 with BAC and higher classification accuracy than any test, or the entire battery of tests, used in the study. Two other studies observed the correlations of −0.76 (154) and −0.88 (153) with BAC in actual traffic stops. ER physicians also observed a highly linear relationship of AON with BAC extending up to 0.40% BAC (153). This is important, as many behavioral indicators of intoxication show marked insensitivity in subjects who have developed a tolerance to alcohol, whereas it appears AON does not.

A fourth study on this issue was conducted in the 1980s and cited in several important HGN critiques and court cases. The following quote from *State v. Witte* (155) cites Pangman (30), who is in turn referring to Norris (personal communication, 1985):

> The data in the study revealed that there was virtually no correlation between the actual value of blood alcohol concentration and the predicted value based upon the angle of onset of nystagmus. However, a correlation did develop between the breath alcohol reading and the level predicted by the alcohol gaze nystagmus. Interestingly, the study concluded that this was caused by the very subjective nature of the test itself: "Since the police officers are the ones operating the breath testing equipment, it appears that, at least in some of the cases, an already known breath alcohol value may have influenced the determination of the angle of onset."

This summation is incorrect and misleading. In fact, an R^2 of 0.53 (r = 0.73; n = 38) was reported when AON was used to predict blood or urine alcohol levels (proportions of blood and urine analysis not reported), whereas a considerably higher value (R^2 = 0.81; r = 0.90; n = 88) was observed when AON was correlated with breath test results. While the difference in correlations is significant, the former value is hardly near to zero and it may be because of the problems inherent in urine alcohol analysis rather than observer contamination.

Conclusions from Visual Research and HGN's Use in DWI Investigations

Eye movement research has shed some light on the HGN issues noted at the beginning of the article and raised some new ones. A review of the vision science literature finds: (i) The NHTSA description of SP as a marble rolling on a glass table does not take into account the irregularities and small saccades often found in the SP of sober subjects, (ii) the NHTSA-recommended speed for SP may be too fast to produce smooth pursuit velocity without visible saccades for some people when sober, even when performed perfectly under favorable conditions, (iii) age has a considerable effect on SP, (iv) increased stimulus speed during SP is associated with not only more saccades, but also higher test–retest reliability of SP measures, (v) visual background characteristics can lower SP quality, (vi) predictable stimuli are followed better than unpredictable targets, (vii) a number of medical conditions and prescription drugs interfere with SP and increase GN, (viii) psychosis and possibly other psychiatric conditions, such as mania and depression, affect SP, (ix) performance when sober on SP and GN tasks strongly predicts performance while drinking in the only study to examine the issue, and (x) test–retest reliability of both SP and gaze nystagmus may be too low for forensic use even when instruments are used and needs further investigation. HGN's *interrater* reliability was identified as a serious shortcoming of manual HGN administration in the first author's previous review (8). Several other potentially important variables (effect of low temperature, wind) have not been addressed at all. Fatigue and anxiety are potentially confounding factors in most DWI stops and have received very little rigorous study. Currently, one published study found that anxiety does not affect smooth pursuit. One unpublished study found no effect of fatigue on any aspect of HGN, while two published studies found decrements in SP when subjects were substantially sleep deprived. Another found DSNMD in 55% of those subjected to experimentally induced fatigue. Two studies, one unpublished, suggest that minor variations from the standard administration may not affect HGN's correlation with alcohol, but the effect on diagnostic statistics was addressed only in the unpublished article, which also found high false-positive errors for all conditions.

However, one criticism of HGN can be dismissed as unsupported by either rational or empirical evidence: Administering HGN slightly above the eye line, as specified in the standard protocol, does not invalidate the test by involving additional eye muscles: all six are involved during all SP movement. Further, this is the only protocol that has received any empirical evaluation.

The results reported here contrast somewhat with the first author's review of HGN sobriety test studies (32). In that review, HGN performed better than other sobriety tests at predicting estimated BAC, although none of the studies were truly blind, and the findings were regarded as circumstantial evidence of validity. In contrast, the eye movement research reviewed here suggests many potential problems. In considering the laboratory vision research, there are important differences between studies of smooth pursuit conducted in laboratories and those that examine SP as part of a field sobriety test. In laboratory studies, the stimulus is presented mechanically or electronically with high precision to the center of the visual field rather than across a span of 120°. Usually, a high contrast stimulus is used against a blank or featureless background. Often many trials are conducted and initial or flawed trials may be discarded. Subjects in laboratory studies are typically screened for health or psychiatric problems that might impair performance and they have no reason to fear "failing" the procedure. Although not specified, presumably most testing is done during the day or early evening. Many of these differences would seem to make SP more challenging in field conditions than in the laboratory settings, making the discrepancy between laboratory eye studies and those of HGN studies all the more puzzling. It is possible that HGN scoring is more affected by the external cues of intoxication than other sobriety tests, and this factor leads to higher, but contaminated, correlations and diagnostic statistics. There are two plausible reasons. HGN scoring appears more difficult and subjective (interrater reliability coefficients are lower) than for other SFSTs, and the fact that the subject's eye movements are not recorded may lead to a lessened sense of accountability: The defendant's performance on other sobriety tests is usually recorded on video, and the jury can compare the officer's account with their own judgments. Either factor may produce scoring errors influenced by observations other than formal HGN clues. Alternatively, perhaps real-life stimuli and backgrounds (as opposed to laser spots and visually sterile environments), and the fact that subjects are assessed on their first few SP passes, facilitate performance over that observed in laboratory settings. Possibly officers are able to distinguish HGN clues from other eye movement irregularities, a claim advanced by one HGN advocate (24).

As noted in the introduction, interrater reliability is probably a serious problem in field HGN, and even the modest figures reported may underestimate the problem. Pearson's r, when used to judge interrater reliability, is primarily sensitive to agreement in the rank order of subjects across raters: It does not account for differences in the values assigned. In other words, two examiners could differ greatly in terms of how many subjects score four clues or more but agree which subject is highest, second highest, lowest, etc. They would nonetheless show high interrater correlation on Pearson's r. Several authors (156–158) have recommended the use of an intraclass correlation coefficient (ICC) to gauge agreement on continuous measures because it takes account of both ranking similarity and agreement on the absolute level.

There are numerous possible sources of HGN interrater disagreement. The original NHTSA researchers reported that officers had considerable difficulty in accurately estimating an angle of 45° within 3° (23). There is also subjectivity in the judgment of when nystagmus has occurred, as its amplitude may vary from far less than 1° to more than 20°. There is little agreement among professionals about the threshold of observation: One author asserted nystagmus of 0.1° is detectable (143), while another group reported that nystagmus of 0.3–0.5° was not visible to the naked eye (159). The second author's experience with optometric clinicians suggests that 1° is the smallest amplitude of jerk nystagmus that clinicians can reliably detect and classify. Predictability and reliability of scoring will break down for nystagmus that is near the threshold of observation. Many people have *non*distinct endpoint nystagmus when sober, and there are no studies that assess how well officers can distinguish this from DSNMD. A high quality video recording of the eyes during HGN could preserve the evidence and allow inspection by the defense lawyer, the jury, and experts, but also risks revealing nystagmus that would not be visible to the naked eye if magnification is used. Interrater reliability appears to be less problematic in research when eye tracings are used.

Another factor contributing to poor interrater reliability may be the difficulty in administering the SP phase with the correct motion and uniform velocity. In video tapes of police-administered HGN, it is common to see noticeable changes in stimulus speed and arcing in the path of the stimulus in either horizontal or vertical planes. Moving a stimulus at a constant speed in a straight line is not a natural motion, requires movement along three joints (shoulder, elbow, and wrist), and is not easy to do. The variations among different test administrators may have a direct effect on HGN's validity. If the officer takes the recommended 2 sec for each pass (from midline to extreme gaze), this translates to an average speed that is barely within many people's smooth pursuit capacity. Any variations from this average will result in some portion of the pass being faster than the prescribed rate, quite possibly causing the eye to lag the stimulus and to catch up using a saccade. These problems, and the difficulties officers have in estimating angle of deviation with passable accuracy, suggest the need for greater training or the use of practical roadside implements. Limitations in the standardization and reliability of scoring limit the validity and classification accuracy that a test can achieve (48).

While interrater reliability and calibration problems might be addressed through instrumentation, limited test–retest reliability is both more interesting and possibly less easily resolved. Even when recorded by instrument, substantial variations in eye movement variables are observed over time, even when subjects are sober at both assessment periods. The general effects of alcohol also tend to be unreliable within and across episodes (130,160,161). Although eye movement performance and alcohol responsivity may covary, this is only one possibility and has never been tested.

An essential aspect of all scientific measurement is that the instruments used are carefully calibrated. This means that the values returned by the instrument have been verified against accepted standards, and through repeated measures, the variability in measurement as a result of instrument noise is known. In the case of HGN testing during SFST, the "instrument" is the arresting officer, who makes a subjective assessment of whether nystagmus is present or "distinct." Presumably, this varies with the number and size of saccades, but no studies have examined the HGN administrator's judgments of saccade frequency and amplitude against an objective eye tracker recording. The "instrument," in the case of HGN, is uncalibrated.

In a chapter for medical readers, noted nystagmus researchers (33) pointedly questioned the use of nystagmus in sobriety testing:

> Unfortunately, that alcohol can produce horizontal gaze-evoked nystagmus has led to a "roadside sobriety" test conducted by law-enforcement officers. Nystagmus as an indicator of alcohol intoxication is fraught with extraordinary pitfalls: many normal individuals have physiologic end-point nystagmus; small doses of tranquilizers that wouldn't interfere with driving ability can also produce nystagmus; nystagmus may be congenital or consequent to structural neurologic disease; and often a neuro-ophthalmologist or sophisticated oculographer is required to determine whether nystagmus is pathologic. Such judgments are difficult for experts to make under the best conditions and impossible to make accurately under roadside conditions. It is unreasonable to have cursorily trained law officers using the test, no matter how intelligent, perceptive, and well meaning they might be. As noted, meticulous history taking and drug-screening blood studies are often essential in evaluating patients with nystagmus. (pp. 26–27)

There appear to be no easy answers to several of these objections, at least at the time of the traffic stop. Evaluation of the patient by an optometrist or ophthalmologist could uncover some of these problems, but only after the defendant has undergone the distress and inconvenience of arrest.

The importance of potentially confounding medical conditions for HGN assessment depends on three factors: (i) the base rate of the condition in the driving public, especially during late night hours, (ii) the percentage of persons with the condition that show eye symptoms, and (iii) whether the eye abnormalities produced closely resemble alcohol-caused nystagmus. Some potential causes are likely to be quite rare among drivers suspected of DWI (e.g., Brown's syndrome). Others might be quite common, but produce symptoms in only a small percentage of those with the condition. Still others may rarely be mistaken for alcohol-induced nystagmus.

Nystagmus can be caused by a variety of things, some external such as visual motion or body rotation, others internal such as vestibular imbalance, neural damage, or chemical toxicity. Adherence to NHTSA's administration standards will control for some possible causes, such as tilting the head (which tilts the semicircular canals) or a moving visual background. Various schemes have been proposed to enumerate distinct types of nystagmus (e.g., the 49 types of nystagmus cited by Dell Osso and Daroff; [33]). However, the vast majority can be described as visual-induced (optokinetic), vestibular (rotational, caloric), gaze-evoked (end-point), or idiopathic (infantile nystagmus). While some have used such lists to assert that there are 49 types of nystagmus other than alcohol-induced, this is not correct: Nystagmus found in HGN qualifies for several of the terms in the list (acquired, horizontal, jerk, associated). Lengthy lists mix descriptive and etiological terms, and some forms of nystagmus are unlikely to be mistaken for HGN. For example, lid nystagmus involves only the eyelids. However, normal end-point nystagmus, square wave jerks, infantile nystagmus, and optokinetic nystagmus could be mistaken for HGN under some circumstances, as might a nystagmus with a vestibular or congenital cause.

Perhaps more important, some medical conditions that damage the cerebellum or neural integrator may disrupt SP and cause gaze nystagmus that is indistinguishable from that caused by alcohol. For gaze nystagmus, there are three likely presentations depending on whether it is congenital or caused by imbalance in the neural integrator or in the vestibular system. Conditions that affect the neural integrator will present gaze nystagmus with the same waveform that is observed when alcohol is the cause: a decelerating drift from the original position of gaze followed by a saccade back to the original position (Fig. 3a). There is nothing for a police officer to discriminate, as the expected waveforms are identical. A congenital nystagmus or one caused by the vestibular system might be able to be distinguished from alcohol-induced nystagmus with training, but this has not yet been demonstrated in a peer-reviewed publication.

While the effects of alcohol on SP and gaze nystagmus are well-established, there is no direct empirical support for DSNMD, the most controversial of the HGN clues (7). Here, research is needed to establish whether it is related to BAC, and if so, whether it provides incremental validity over AON. Booker's findings that it is sensitive to fatigue and recent alcohol use after BAC has reached 0.00% require replication, but cast a heavy shadow over this indicator.

HGN has been studied almost exclusively for predicting BAC, not behavioral impairment. While substantial correlations have been reported, no study has reported an *average* error of estimate of <0.03% (Standard Error of the Estimate = 0.0376; [162]), so that a 95% confidence interval spans a range of 0.147% BAC. Partly for this lack of precision, HGN is not admissible to prove a specific BAC in any jurisdiction. Rather, it is admissible to establish probable cause or as circumstantial evidence of behavioral impairment. But there are no studies demonstrating HGN's validity for gauging physical, behavioral, or driving deficiencies. Only one study (163) reported correlations of HGN with other sobriety tests and number of computer-administered cognitive tasks. While moderate correlations were observed (r_s = 0.30–0.60), all were substantially less than HGN's correlation with BAC (r = 0.77). Thus, there is very minimal evidence of HGN's validity on the loss of mental ability, and none at all on loss of physical or driving ability.

It is unclear whether nystagmus is an indication of visual impairment. Regarding the significance of gaze nystagmus, the authors of one respected text stated that it "does not produce great functional disability since the eyes are used mostly near the central position" ([13], p. 254). Both for lateral gaze and during SP, the presence of nystagmus does not necessarily impair vision. A number of studies on congenital forms of nystagmus suggest that as long as 50 msec of foveation is obtained, visual acuity is maintained (164–168). Alcohol at moderate doses reduces the maximum velocity of saccades but does not affect acuity (169), although this may be because acuity testing is usually performed at primary gaze, not with the eyes deviated or following a moving target. Lastly, these effects have been indexed by BAC, not nystagmus. However, one study (170) reported that nystagmus (not further described) provided incremental validity over BAC in predicting deficits in visual search. This was true of groups above and below 0.08% BAC, as well as the total sample.

NHTSA Training and Its Sufficiency

There are numerous problems with the standard NHTSA training for HGN. Perhaps most notable, a total of perhaps 3 h classroom and demonstration time, out of a 3 day course, is devoted to HGN. Typically, this consists of viewing video tapes demonstrating alcohol-induced nystagmus and group examinations of subjects, most of whom are dosed with alcohol. The discussion of other types of nystagmus covers about one page, while the entire subject of medical causes of nystagmus is as follows: "Nystagmus may also be caused by certain pathological disorders. They include brain tumors and other brain damage or some diseases of the inner ear. These pathological disorders occur in very few people and in even fewer drivers" (1, p. VIII-11).

NHTSA's description of both normal eye movements and those under the influence of alcohol is inaccurate. SP in sober individuals has been described as "like a marble rolling on glass" (1, p. VIII-5) and in recent editions of the NHTSA manuals, like a windshield wiper on wet glass. These analogies do not describe the eye movements of some sober individuals, which may be uneven or jerky (13,58,71,72,171). NHTSA does not acknowledge this or that there are other nystagmus-like movements, such as square wave jerks, which might be mistaken as alcohol-induced nystagmus (see Fig. 3). The initial error in SP tracking is not mentioned in NHTSA training materials. The initial, fast passes to check for equal tracking of the eyes may well produce nystagmus in sober people, and without explicit warning, police officers may be biased by observing it immediately before performing the assessment for breakdown of SP.

Breakdown of SP is also described inaccurately by NHTSA as being like a marble rolling on sandpaper (1,2), an analogy that suggests vertical, not horizontal, perturbations. Alcohol-induced nystagmus creates a specific waveform, whether occurring during SP or gaze: There is a slow, decelerating drift off the target followed immediately by a saccade back to the target. Officers are not taught to look for this specific waveform, either in their text or in video examples (1,2). Whether such training can teach officers to make such distinctions on commonly occurring, potentially confounding eye movements should be determined immediately, and if successful, incorporated into NHTSA training.

The implicit emphasis of NHTSA training is on *detecting* intoxication, and police officers may never evaluate a substantial number of persons who have not been drinking before being assigned to traffic duty. An alternative model might define the purpose of testing as to *distinguish* those who are legally intoxicated from those that are not. Police officers who do not test many sober people may never come to question NHTSA's inaccurate description of normal SP and may regard any jerking movement of the eye as alcohol-induced nystagmus. This risk is increased when they are explicitly told that medical conditions that can cause nystagmus are rare among the driving population (1,2).

NHTSA publications often emphasize the overall accuracy rates or the "correct arrest" rates. Both take advantage of the high base rates of intoxication in many of the NHTSA study samples. NHTSA publications typically do not report the false-positive rates, which are independent of base rate and are often quite substantial. Correct arrest rates, which are equivalent to positive predictive power, will always exceed the base rate (172). Thus, an 88% correct arrest rate in one NHTSA study (38) is less impressive when the 0.72 base rate is considered: HGN increased the accuracy rate by only 16% of the sample. When the base rate is low, as in

TABLE 5—*Advantages and disadvantages of HGN as a field sobriety test.*

Advantages	Disadvantages
1. Highest correlation with BAC (blood alcohol concentration) of any established field sobriety test	1. Lacks specificity for alcohol; sensitive to a number of medical and psychiatric conditions and some prescription drugs
2. Most empirical support of any sobriety test	2. Many potential confounding factors not thoroughly investigated
3. Sensitive to low levels of BAC	3. Often performed incorrectly in the field
4. Appears to remain calibrated to BAC even in alcohol-tolerant drinkers	4. Not demonstrated to be related to behavioral or driving impairment
5. Easily administered, requires no special equipment	5. Environmental conditions at stop differ from laboratory testing, may reduce validity or create false positives
6. Requires little verbal instruction, could be administered to non-English speakers if nonverbal instructions developed	6. Ability of field officers to distinguish between alcohol-induced nystagmus and other eye movements not demonstrated
	7. Lacks face validity, so juries give it less weight than psychomotor tests
	8. In jurisdictions where considered a scientific test, may face admissibility hurdles

daytime or sobriety checkpoint stops, false-positive errors may greatly outnumber valid arrests.

Strengths and Limitations

While HGN has many problems, it is not without its virtues. Table 5 lists its advantages and disadvantages relative to other non-chemical field sobriety tests. The only real rival to HGN, when BAC is the criterion, is AON. It has shown higher levels of correlation and accuracy of classification in several studies, although the optimal formula has varied somewhat across studies. Although there is less empirical support for AON than HGN, it has several advantages. Unlike HGN, it can provide a continuous scale of test performance that is linearly related to BAC. While HGN is likely to "top out" at BAC levels of 0.08–0.12%, AON does not. An AON of 20° could provide stronger evidence of intoxication than an HGN score of 6. Secondly, because GN relies on fewer brain centers and does not depend on unrestricted movement of the globe (which may be impaired by Brown's syndrome or irregularities in the orbit), it may be less susceptible to false-positive errors. Lastly, gaze may be less affected by stimulus qualities than SP. However, these advantages could not likely be achieved without the use of instrumentation, and there is much less research on gaze nystagmus and the variables that affect it than for SP.

Conclusion

While the sobriety testing literature provides circumstantial evidence of HGN's validity when BAC is used as a criterion, the eye movement literature raises serious questions about its use as a roadside sobriety test. Primary among these is how many sober subjects' SP at 30°/sec is free of observable saccades. Roadside testing entails several factors that probably disadvantage the SP system, including the presence of a meaningful background (e.g., the officer's face), effects of fatigue, fear, or circadian rhythms, unpredictable stimulus speed, and testing at eccentric view angles. There is very minimal data to support the validity of HGN for gauging mental, physical, visual, or driving impairment. The clue of breakdown of SP is significantly biased against older people, and the age at which this disadvantage becomes significant has not been established. HGN appears potentially vulnerable to false-positive errors from a number of medical and situational conditions as well as prescription drugs. NHTSA does not adequately address these and other issues in its training materials and curriculum. Lastly, peer-reviewed research needs to address many of the points made in this article, including the effects of anxiety and fatigue on HGN, and the relationship between HGN, alcohol, and driving performance.

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Special Commission on Operating Under the Influence and Impaired Driving

November 9, 2018
1:00 PM

Massachusetts Gaming Commission
101 Federal St., 12th Floor
Boston, MA 02110

SPECIAL COMMISSION ON OPERATING UNDER THE INFLUENCE AND IMPAIRED DRIVING

Agenda

1. Call to order
2. Approval of minutes
    - October 12, 2018
3. Presentation by Matt Allen, American Civil Liberties Union-Massachusetts Field Director
4. Discussion
5. Legislative Report Outline Discussion
6. Report Work Plan
7. New business that the chair did not anticipate at time of posting
8. Scheduling
9. Adjournment

Operating Under the Influence of Cannabis: Science, data, and civil liberties concerns

Prepared for the Special Commission on Operating Under the Influence and Impaired Driving

Matt Allen, Field Director
Shireen Younus, Intern

November 9, 2018

ACLU Massachusetts

Operating Under the Influence of Cannabis

Scope of the Problem:

- How impaired are drivers under the influence of cannabis?
- How does the increase in traffic fatalities in states that have legalized cannabis compare with those who have not?

Testing for Impairment:

- How reliable are blood, saliva, or Drug Recognition examinations?

Civil Liberties Issues:

- What do the courts say?
- How could new laws impact medical cannabis patients?
- How could new laws impact other drivers?

Recommendations

How impaired is a driver who is under the influence of cannabis?

How impaired is a driver who is under the influence of cannabis?

- In general, marijuana-positive drivers possess little elevated risk of motor vehicle accident compared to drug free drivers, after adjustment for potential confounding variables. However, marijuana combined with alcohol are consumed concurrently, risk increases significantly. Inhaled cannabis's influence on performance is typically short lived, the influence of cannabis is subtle, and frequent users develop a tolerance.

Crash Risk Elevation is not High

- 66 studies, 264 estimates of the effects of accident risk on illicit or prescribed drugs. 10 estimates for cannabis, increase in risk of fatality of 1.3.

Risk of road accident associated with the use of drugs: A systemic review and meta-analysis of evidence from epidemiological studies, Rune Elvik, Accident and Analysis Prevention, 2013

- 3,000 crash involved drivers and 6,000 control drivers. Found that drivers were 1.25 times more likely to be involved in a crash but the effect disappeared when age, gender, alcohol concentration and other factors were taken into account. THC adjusted risk factor is 1.05; alcohol at .07 BAC is 3.22

Drug and Alcohol Crash Risk, Richard Compton and Amy Berning, NHTSA, 2015.

- Compared to drivers testing negative for alcohol and marijuana the adjusted odds ratios of fatal crash involvement were 16.33 for those testing positive for alcohol and negative for marijuana, 1.54 for those testing positive for marijuana and negative for alcohol and 25.09 for those testing positive for both alcohol and marijuana.

Interaction of marijuana and alcohol on fatal motor vehicle crash risk: a case-control study. Center for Injury Epidemiology and Prevention, Department of Anesthesiology… Columbia University. Injury Epidemiology, 2017.

The Effect of Inhaled Cannabis is Subtle

- THC's adverse effects on driving performance appear relatively small
  Robbe. 1993. Marijuana and actual driving performance: Final report for DOT
- [M]ost marijuana-intoxicated drivers show only modest impairments on actual road tests.
  Sewell et al., 2009. The effect of cannabis compared with alcohol on driving
- Performance as rated on the Driving Proficiency Scale did not differ between treatments (cannabis versus placebo). It was concluded that the effects of low doses of THC … on higher-level driving skills as measured in the present study are minimal.
  Lamers et al., 2001. Visual search and urban driving under the influence of marijuana and alcohol

Cannabis' Influence is Short Lived

- Peak acute effects following cannabis inhalation are typically obtained within 10 – 30 minutes.

NHTSA. Drugs and Human Performance Facts Sheets

- Experimental research on the effects of cannabis … indicat[e] that any effects ... dissipate quickly after one hour.

NHTSA. State of Knowledge of Drug-Impaired Driving: FINAL REPORT

- Current research suggests that … impairment from cannabis typically clears 3-4 hours after use. This time span could be recommended to users as a minimum wait period before driving.

Fischer et al. Lower risk cannabis use guidelines for Canada, 2011

Experienced Users Become Tolerant

- [F]requent marijuana users may show fewer behavioral signs of disruption during intoxication than infrequent users, even when difficult memory tasks are used to assess cognitive performance. These data emphasize the importance of taking into account the drug-use histories of research participants and examining multiple measures when investigating marijuana-related effects on cognitive functioning.
  Hart et al., 2010. Neurophysiological and cognitive effects of marijuana in frequent users.
- 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.
  Grotenhermen and Mueller Vahl. 2012. The therapeutic potential of cannabis and cannabinoids
- Patients receiving treatment with MARINOL® Capsules should be specifically warned not to drive, operate machinery, or engage in any hazardous activity until it is established that they are able to tolerate the drug and to perform such tasks safely.
  USFDA

How does the increase in traffic fatalities in states that have legalized cannabis compare with those who have not?

Fatal traffic accidents are similar between states that have legalized cannabis and those that have not.

- "On average, MML states had lower traffic fatality rates than non-MML states. Medical marijuana laws were associated with immediate reductions in traffic fatalities in those aged 15 to 24 and 25 to 44 years, and with additional yearly gradual reductions in those aged 25 to 44 years.“
  US Traffic Fatalities, 1985-2014, and Their Relationship to Medical Marijuana Laws, Jlian Santaella-Tenorio et al., American Journal of Public Health, 2017.

- "Pre–recreational marijuana legalization annual changes in motor vehicle crash fatality rates for Washington and Colorado were similar to those for the control states. Post–recreational marijuana legalization changes in motor vehicle crash fatality rates for Washington and Colorado also did not significantly differ from those for the control states. … Three years after recreational marijuana legalization, changes in motor vehicle crash fatality rates for Washington and Colorado were not statistically different from those in similar states without recreational marijuana legalization.”
  Crash Fatality Rates After Recreational Marijuana Legalization in Washington and Colorado, Jasyson Aydelotte et al., American Journal of Public Health, 2017.

- "We find that states that legalized marijuana have not experienced significantly different rates of marijuana- or alcohol-related traffic fatalities relative to their synthetic controls. ... In summary, the similar trajectory of traffic fatalities in Washington and Colorado relative to their synthetic control counterparts yield little evidence that the total rate of traffic fatalities has increased significantly as a consequence of recreational marijuana legalization.”
  Early Evidence on Recreational Marijuana Legalization and Traffic Fatalities, Benjamin Hansen, Keaton Miller, Caroline Weber, National Bureau of Economic Research, 2018.

Why does data in Washington show a spike in THC in blood of drivers who were involved in accidents in 2013 and after?

- "Prior to 2013, the laboratory did not routinely conduct an immunoassay screen for drugs in suspected impaired driving cases where the blood alcohol concentration was >0.10 g/100 mL."

The Prevalence of Marijuana in Suspected Impaired Driving Cases In Washington State, Fiona Couper and Brianna Peterson, Toxicology Laboratory Division, Washington State Patrol, 2014.

Is there a way to detect impairment caused by cannabis?

Blood tests

- 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

Blood Tests

- 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

Blood Tests

- 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

Saliva Tests

Lab studies commonly report the detection of THC in oral fluid for 48 hours or more after smoking at sensitivities of .5ng/ mL. Some samples were positive at 72 hours… average periods of 13-15 hours

- Average THC detection time of the last OF positive after smoking was 31 – 34 hours. Some samples were positive at 72 hours at levels ≤1.2 ng.
  Niedbala, RS et al, "Detection of MJ Use by Oral Fluid and Urine Analysis Following Single-dose administration of smoked and oral MJ" Journal of Analytical Toxicology 25 Jul/Aug 2001

- Tested 21 heavy users diagnosed as cannabis "dependent" for 7 consecutive days. THC was detectable in OF up to 78 hours. Mean detection time was on the order of 24 hours.
  Odell MS et al. "Residual cannabis levels in blood, urine and oral fluid following heavy use," Forensic Sci Int. 2015 Apr; 249:173-80.

- Examined 28 regular smokers during monitored abstinence of 4 to 33 days. Mean THC detection rates decreased from 89.3% at admission to 17.9% after 48 hours.
  Dayong Lee, Ryan Vandrey, Damodara R. Mendu, Jeannie A. Murray, Allan J. Barnes, and Marilyn A. Huestis, "Oral fluid cannabinoids in chronic frequent cannabis smokers during ad libitum cannabis smoking," Drug Test Anal. 2015 Jun; 7(6): 494–501

- Found that THC was detected at levels ≥ 0.5 ng in all smokers after 13.5 hours and in 62% of frequent users and 40% of occasional users at 28 hours.
  Newmeyer M, Desrosiers N, Lee D, Mendu D, Barnes AJ, Gorelick DA and Hustis M, "Cannabinoid disposition in oral fluid after controlled cannabis smoking in frequent and occasional smokers," Drug Testing and Analysis Feb. 2014

DRE validity is based on three parent studies

Bigelow (1985)

80 healthy adult male volunteers aged 18-35, paid $80, trained in SFST, given placebos or drugs on site, then examined by four DREs. False positives – 1.3% no drug, 7% incorrect drug identified.

“These data show the specificity of raters’ intoxication judgements to be high – with 80%, 97.5% and 92.7% of cases judged to be intoxicated on stimulants, marijuana, or depressants, respectively, actually having received those drug classes.”

DRE validity is based on three parent studies

Compton (1986)

173 adult suspects arrested for DUI were evaluated by DREs and then given blood tests, 100% were judged to be impaired by drugs other than alcohol.

94% (162) of the evaluations were correct since 11 participants had taken no drugs. DREs correctly identified which drugs the suspect had used in 49% (85) of the cases. They were wrong in 23 cases (13%) – 1 sober suspect, 10 OUI alcohol, and 12 who had drugs in their system that the DRE did not identify. In 46 cases (21%) DREs said a drug was present that did not appear in the blood test.

DRE validity is based on three parent studies

Adler (1994)

484 arrested drivers were evaluated by DREs and given a toxicological analysis over a 53 month period.

DRE decisions were supported by laboratory analysis for 83.5% (404) of the suspects and not supported in 16.5% (80 cases). Drugs were not found in the samples from 26 individuals who the DREs judged not to be under the influence of drugs. There were 42 false positives for drugs.

Methodological Flaws in Studies

Bigelow

- "It is unclear as to what extent the subjects themselves, who were instructed to be cooperative, may have provide information aiding in drug identification." Because it was a lab-run study, the subjects were much more accommodating of police than subjects would normally be in field settings.
- Sample Bias – "Participants were 80 normal, healthy adult male volunteers between 18 and 35 years of age, weighing between 54 and 1000 kg."

Compton & Adler

Spectrum Bias

- "Compton and Adler's study groups were distorted by the inclusion only of people arrested for chemically impaired driving. These studies were both subject to what may be called forensic spectrum bias—spectrum bias arising in sample populations preselected to be guilty beyond a reasonable doubt."

The Methodological quality of three foundational law enforcement drug influence evaluation validation studies, Kane, Journal of Negative Results in Biomedicine, 2013.

Compton & Adler

Misclassification Bias

- Studies conflated finding presence of drugs in the blood as meaning that a person is impaired.
  "Does drug in the blood or urine correctly classify people as drug impaired? The answer is, it may not. Low levels of drugs and metabolites are found in the body hours or even, depending on the drug, days after impairing effects have ended."
- The studies sought to fix this by using a physical test in addition to the blood test to determine impairment, but this conflates side effects with impairment.
- Up to 80% of the drug "predictions" made by officers were made in situations in which suspects had either confessed to taking drugs or officers had conducted a search and found drugs.

Compton & Adler

Selection Bias

- Like in Bigelow, the spectrum of subjects in the study is not representative of the subjects who would actually undergo this evaluation in practice.
- In addition, there is no clearly defined selection criteria of subjects or officers.

Conclusion

"Bigelow, Compton and Adler, the three validation studies commonly cited in American criminal prosecutions to quantify the accuracy of current US law enforcement DIE (drug influence evaluation) practice, did no reference testing of driving performance or physical or mental impairment, investigated tests different from those currently employed by US law enforcement, used methodologies that biased accuracies, and reported DIE accuracy statistics that are not externally valid. **The LEDA (law enforcement drug assessment) accuracies reported by these studies do not quantify the accuracy of the DIE process now used by US law enforcement. These validation studies do not validate current DIE practice."**

ACLU

Civil Liberties Issues

The Courts

Commonwealth v. Thomas Gerhardt (2017)

- Police officers may testify to observed physical characteristics of the driver, but may not offer the opinion that these characteristics mean the driver is under the influence of marijuana.
- A police officer may only testify as to what the driver did during the performance of the road assessments, but may not say that the driver "passed" or "failed" based on the driver's performance.
- A police officer may not suggest on direct examination that an individual's performance on a FST established that the individual was under the influence of marijuana.

The Courts

Commonwealth v. Carpinto (2018) 1:28 Summary disposition

- Car accident in Salem, defendant almost falls over three times after getting out of the car, nodded off twice while FST was being explained. DRE found effects to be “extreme”.
- Behavior of defendant provided probable cause he was impaired.
- An officer does not need probable cause that a defendant is under the influence of any **specific** drug to arrest for OUI.

The Courts

Birchfield v. North Dakota, Supreme Court, 2015

- Driver refused to allow blood to be taken in implied consent state.
- “The Fourth Amendment permits warrantless breath tests incident to arrests for drunk driving but not warrantless blood tests.
- Blood tests “require ‘piercing of the skin’ and extract a part of the subject’s body… and thus are significantly more intrusive than blowing into a tube.”
- “Motorists may not be criminally punished for refusing to submit to a blood test based on legally implied consent to submit to them.”

Racial Profiling in Traffic Stops

- Found racial disparities between white and non-white residents who were stopped in traffic stops in which individuals received a written warning or citation, using data collected by the Registry of Motor Vehicles.
- 18 communities had disparity of over 10%.
- They also found that non-white drivers received more citations than white drivers.
- Of 266 law enforcement agencies, they found substantial racial disparities in 249 agencies.
- The study was also limited because it only included date about traffic stops where a citation was issued but not when a motorist was pulled over and no citation was issued.

Farrel et al, Massachusetts Racial and Gender Profiling Study. Northeastern University Institute on Race and Justice: May 2004.

Racial Profiling in MA

- Massachusetts State Police are more likely to search black and Hispanic drivers than they are to search white ones, an analysis of 3.4 million traffic stops shows, though contraband is found in minority drivers' vehicles at a lower rate than white's.
- This study found that black people were stopped at double the rate that white people were.

The Open Policing Project at Stanford University, Working Paper.

Racial Profiling in MA

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The Open Policing Project at Stanford University, Working Paper.

Medical Cannabis Patients

- 21 dependent cannabis users were tested while in detox over 7 days.
- In some subjects THC was detectable in blood for at least 7 days and oral fluid specimens were positive for THC up to 78 h after admission to the unit. Urinary THC-COOH concentrations exceeded 1000 ng/mL for some subjects 129 h after last use.

Residual cannabis levels in blood, urine, and oral fluid following heavy cannabis use. Odell, Frei, Gerostamoulos, Chu, and Lubman, Forensic Science International, 2015.

Medical Cannabis Patients

"And it shocked everyone, including ourselves, that we could measure, in some of these individuals, THC in the blood for 30 days," says Marilyn Huestis a toxicologist with the University of Maryland School of Medicine who recently retired from leading a lab at the National Institute on Drug Abuse.

Scientists Still Seek A Reliable DUI Test for Marijuana, July 2017

Recommendations

Recommendations

- Studies that correlate the influence of a particular drug and ability to drive a motor vehicle.
- Studies that correlate the concentration level of a particular drug and performance on Standardized Field Sobriety Tests
- Studies that determine the accuracy and specificity of currently used DRE evaluations using widely accepted scientific protocols.

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For more information:

Matt Allen: mallen@aclum.org

ACLU

WE THE PEOPLE

Special Commission on Operating Under the Influence and Impaired Driving

<u>Future Meetings</u>

- November 16, 2018
  - Department of Transportation, 10 Park Plaza, Board Room, Boston, MA
- December 7, 2018
  - Massachusetts Gaming Commission, 101 Federal Street, 12th Floor, Boston, MA
- December 21, 2018
  - Massachusetts Gaming Commission, 101 Federal Street, 12th Floor, Boston, MA

Next Public Meeting of the Cannabis Control Commission

November 20, 2018
1:00 PM

Massachusetts Health Policy Commission
50 Milk Street, 8th Floor
Boston, MA 02109

Marijuana and Driving

Driving High is Impaired Driving: research clearly shows that THC in marijuana negatively affects driving abilities

“I Drive Better Stoned”; “Driving Better High”

- Sample web sites here demonstrating the belief of some people that they are more competent drivers when driving under the influence of marijuana.

The Facts: Here’s What We Know

- Whether you smoke, vape, or swallow edibles--next to alcohol, marijuana is the drug most commonly found in drivers involved in collisions.
- THC enters the bloodstream rapidly if smoked. Edibles have a delayed effect.
- THC disrupts key parts of the brain that influence perception of time, concentration, movement, memory, and coordination—all key to safe driving.

THE BLUNT TRUTH: How THC Affects Driving

- Difficulty maintaining attention
- Slower reaction time and slowed decision-making
- Lane drift (harder to stay in lane)
- Harder to judge distances
- Reduced peripheral/side vision
- Diminished coordination
- Bottom line: Drivers who have ingested may not be able to accurately perceive the traffic environment, make good decisions or take appropriate actions

Prevalence of Marijuana Use Among Drivers in Fatal Crashes: Washington, 2010-2014 AAA Foundation for Traffic Safety Study

Did prevalence change after recreational marijuana became legal in WA in December, 2012?

Methadology

- Data from Washington Traffic Safety Commission
- Examined all crashes on WA public roads that resulted in a death within 30 days
- Examined presence/concentration of THC in blood toxicology results from drivers involved in fatal crashes
- Concentration of THC in the subset of drivers whose blood was not tested was estimated using multiple imputation

Results

- From 2010-2014, 10.0% of drivers involved in fatal crashes had detectable THC in their blood at the time of the crash
- Of all THC-positive drivers involved in fatal crashes, an estimated 34.0% had neither alcohol nor other drugs in their blood
- In 2013, after recreational marijuana was legalized in 2012, the number of fatal crashes doubled from 49 in 2013 to 106 in 2014
- Analysis of trends over time before and after Initiative 502 took effect indicate that the proportion of drivers positive for THC was generally flat before legalization, but began increasing significantly about 9 months after the effective date of legalization.

But in general, research shows:

Peak effects occur 10-30 mins after last puff
Many drivers are acutely impaired 2-5 hours after ingesting marijuana
THC can be detected more than two weeks after last use

body, and subsequently, how they impair driving

High drug levels may drop below legal thresholds before a test can be administered to a suspected impaired driver. Using per se limits to prosecute could result in some unsafe drivers going free, and others being wrongly convicted for impaired driving.

to require:

a positive test for recent marijuana use

Behavioral and psychological evidence of impairment: heavily reliant on drug recognition experts

MOTOR VEHICLE

Massachusetts
Police Manual
2018

10 OUI & Alcohol Offenses

ELEMENTS OF OUI: G.L. c. 90, § 24

OPERATION

A person "operates" a motor vehicle by driving or doing any act that tends to set the vehicle in motion. *Comm. v. Uski*, 263 Mass. 22 (1928).

- ***Driving.*** This is the most obvious way to operate.
- ***Any act tending to set vehicle in motion.*** *Comm. v. McGillivary*, 78 Mass. App. Ct. 644 (2011) (sufficient evidence: passed out defendant, in his parked car in front of a restaurant, had turned the key in the ignition to listen to the radio). *Comm. v. Clarke*, 254 Mass. 566 (1926) (shifting gears causing car to roll forward is operation).
- ***Stopped in course of driving.*** A driver continues to operate when his vehicle stops in the ordinary course of travel for a reason related to its operation. *Comm. v. Balestra*, 18 Mass. App. Ct. 969 (1984) (defendant seen driving from bar later found wedged behind steering wheel of his wrecked vehicle). On the other hand, operation ends when a person parks and leaves his vehicle for a reason unconnected to its operation. *Comm. v. Cavallaro*, 25 Mass. App. Ct. 605 (1988).

Proof of Operation

Observe. Seeing a person driving, or having a witness, is the most common form of proof.

Circumstantial Evidence. Officers may also prove that a person operated without witnessing him driving.

- ***Sufficient evidence: Asleep at wheel.*** *Comm. v. Otmishi*, 398 Mass. 69 (1986) (no defense to OUI that driver voluntarily parked his car to "sleep it off"; those under the influence should not get behind the wheel in the first place). *Comm. v. Pisano*, 2016 WL 154766 (Appeals Court) (defendant was asleep in the driver's seat on a "dirt pull off" with the keys in the ignition, the engine running, the dashboard illuminated, and the headlights on).

- ***Sufficient evidence: Containers in vehicle — "drinking after stopping" no defense.*** *Comm. v. Donovan,* 2014 WL 2861761 (Appeals Court) (intoxicated defendant was in driver's seat, with keys in the ignition, and empty and partially empty containers of alcohol in the vehicle; the vehicle was entirely off the road, but tire tracks in the mud led from the highway to the place where the vehicle was stuck; defendant claimed he began drinking after he became stuck, but his statement to police that he had left the airport only 40 minutes earlier did not leave him enough time to become intoxicated).

- ***Sufficient evidence: Association with vehicle and scene.*** *Comm. v. Leblanc,* 2014 WL 2861767 (Appeals Court) (after a report that an intoxicated customer at Ocean State Job Lot drove her red Kia sedan into a shopping cart, police ran the plate and went to Elaine Leblanc's home; the red Kia was in the driveway; Leblanc told police that she had driven to buy curtains; police determined that she was intoxicated and observed several dents on her vehicle).

  Comm. v. Robichau, 2016 WL 192058 (Appeals Court) (defendant was sitting in the middle of a bench seat moments after the car was sideswiped on the driver's side, causing the side window to shatter and airbag to deploy; she initially denied anyone else was in the truck, and had facial wounds consistent with airbag deployment; her purse was under the driver's seat, and her cell phone was in the pocket of the driver's door).

- ***Insufficient evidence: More than one possible driver.*** In *Comm. v. Mullen*, 3 Mass. App. Ct. 25 (1975), the defendant and the other occupant (who was killed) were ejected in a way that made it impossible to determine which one had been driving.

  Compare *Comm. v. Beltrandi*, 89 Mass. App. Ct. 196 (2016): An officer approached a car that was stopped on Route 9 in Ware. ⅔ of the car was in the road and ⅓ was over the fog line. The engine was running and the lights were out. A woman was in the driver's seat and a man in the passenger seat. The windows were fogged up and the couple was partially clothed. The officer spoke to the woman, who said they were on their way home from a bar and had been engaging in sexual activity. The officer determined that the woman was intoxicated and arrested her for OUI.

  There was sufficient evidence that the woman was the driver, even though a second person was in the vehicle. Not only was she in the driver's seat, but she was also severely intoxicated, while her companion was not. The manner in which the car was parked suggested it had been driven by someone under the influence of alcohol.

  Comm. v. Gomez, 2017 WL 3122324 (2017): After the defendant's vehicle struck a pole, two men exited the vehicle through the only door that would open. The defendant told police that the other man was driving, but there was sufficient evidence that the defendant was the driver. The other occupant told police the defendant was "driving very fast," the car belonged to the defendant, the other occupant did not have a license and did not know how to drive, and the crash happened near the defendant's brother's house, in an area with which the other occupant was unfamiliar.

- ***Insufficient evidence: Driver's admission only <u>and</u> more than one possible operator.*** In *Comm. v. Leonard*, 401 Mass. 470 (1988), officers responded to a highway rest area where Leonard was fighting with his wife over the car keys. He was intoxicated and admitted to officers that he drove before the altercation. He was arrested for OUI. However, his wife testified at trial that she had been the operator. The SJC found that officers did not have enough evidence that Leonard drove — even though he demanded that his wife "give back the keys" and police found his wife's cigarettes on the passenger side of the car!

  The moral of *Leonard*: <u>Never assume</u> that an admission from the suspect is sufficient when there is more than one possible driver. *Comm. v. Boothby*, 64 Mass. App. Ct. 582 (2005) (fact that defendant was registered owner did not, by itself, corroborate his admission that he drove when there was more than one possible driver).

  Compare *Comm. v. Knorr*, 2015 WL 9467405 (Appeals Court) (although the defendant claimed his girlfriend had been driving before they ran out of gas, there was sufficient evidence he was the operator: he owned the car; he was in the driver's seat when police arrived; the girlfriend was in the passenger seat; the key was in the ignition; and the driver's seat was set to the defendant's height, which was substantially taller than his girlfriend).

PUBLIC WAY

Three different locations constitute a public way:

- ***Public way.*** This obviously includes highways and municipal streets. G.L. c. 90, § 1. Features indicate their public nature — e.g., paving, street lights, signs, curbing, fire hydrants, and maintenance (garbage collection and plowing). *Comm. v. Hazelton*, 11 Mass. App. Ct. 899 (1980) (public way regularly patrolled by police, visible "no parking" signs, and municipally paved and plowed).

- ***Public right of access.*** The second alternative is an area of public access. *Comm. v. Kiss*, 59 Mass. App. Ct. 247 (2003) (a "strip mall" parking lot, even during hours when mall shops closed, provided public access because services such as an ATM, trash receptacle, and newspaper box could be used at all times by motorists). *Comm. v. Ortiz,* 2012 WL 5231959 (Appeals Court) (road within condo complex allowed public access; it was the primary means of vehicle access for residents of 144 units and their guests; no signs limited access). *Comm. v. Pisano*, 2016 WL 154766 (Appeals Court) (defendant was asleep in his running vehicle in a "dirt rest area" or "dirt pull off" where motorists could pull off the main road to rest; this was a place where the public had a right of access).

  However, this phrase is limited to places where *motorists* have access. *Comm. v. George*, 406 Mass. 635 (1990) (baseball field did not qualify as public way because it is not designed for vehicle access).

- ***Public access as invitees or licensees.*** This is the third alternative.

  - **"Invitees" (typically customers) are present at the owner's request.** *Comm. v. Smithson*, 41 Mass. App. Ct. 545 (1996) (road inside gate of commercial gravel pit not public; the facility was not open; the gate was shut; and a sign was conspicuously posted indicating hours of operation).

  - **"Licensees" are present with the owner's passive permission** — e.g., a person driving on a private way that is commonly used by the public without the owner's objection. *Bruggeman v. McMullen*, 26 Mass. App. Ct. 963 (1988) (history of use for road is key factor).

  - **Status of way, not driver, controls.** The defendant need not personally qualify as an "invitee" or "licensee," since it is the status of the way and *not* the driver that controls. *Comm. v. Brown*, 51 Mass. App. Ct. 702 (2001) (fact that defendant might be trespassing was irrelevant, since he was caught driving drunk on roads within Otis Air Base, which are routinely traveled by public vehicles involved in military *and* civilian activities). *Comm. v. McKee*, 2016 WL 873012 (Appeals Court) (defendant crashed his car into a tree on a dirt road, abutted by 10 houses, which was used as a "cut-through" to other streets; there were street lights on the road, no signs prohibited the public from using it, and town employees plowed it when it snowed; these characteristics showed the road was open for travel to invitees or licensees of the residents in the 10 homes).

  - **Objective appearance of way, not intent of owner, determines status.** *Comm. v. Muise*, 28 Mass. App. Ct. 964 (1990) (private street into trailer park was a public way because it was paved and had street lights, abutting houses, traffic signs, and no signs prohibiting access). Compare *Comm. v. Virgilio*, 79 Mass. App. Ct. 570 (2011) (shared driveway between two houses not public way).

  - **Gate totally restricting access.** *Comm. v. Stoddard*, 74 Mass. App. Ct. 179 (2009): On the roads of a privately owned campground, Brian Stoddard drove drunk. The campground had only one entrance with a gate, which opened only with an electronic "gate card." The cards were issued to registered campers. Non-campers wishing to enter had to go to the office. They were not allowed in after 10:00 p.m. A network of unpaved roads connected campsites. There were no signs or lights.

    The Appeals Court said "the essential question . . . is whether the way is [or appears to be] available for public use." In this case, no motorist approaching the entrance to the campground would believe that he was welcome to drive there. The fact that the campground solicited business was irrelevant. While members of the public are invited to become guests, they are not allowed in unless they acquire a pass.

    The court was aware of the public safety implications of its decision: "We recognize that our conclusion may call into question whether the [OUI] statute covers roadways within private gated communities, . . . resorts, or even some college campuses, to the extent they restrict or bar access by the general public." Prosecutors must distinguish the campground in *Stoddard* from the typical "gated community," which has less stringent access requirements and features paved roads often indistinguishable from adjacent public streets.

Proof of Public Way

Officer testimony is the most common proof. Don't forget, it is an element of the case.

- ***If vehicle traveled on public way while driver under the influence, it does not matter that it ended up on a private way or off-road.*** *Comm. v. MacMillan*, 2012 WL 1058788 (Appeals Court): MacMillan found in his car in a ditch just off the MBTA tracks in Ashland; he told police he had some drinks at a restaurant in Framingham earlier. In order to get there, he must have driven on a public way. *Comm. v. Belliveau*, 76 Mass. App. Ct. 830 (2010): Boston Police arrived after receiving a 911 call that an intoxicated individual drove his pickup truck onto Pier 4 in the Charlestown Navy Yard. The pier is surrounded by water and accessible only from public streets. The operator must have driven on a public way to get there (where he urinated on his truck with a beer in his hand!).

- ***If public way may be an issue, consider also charging OUI in a recreational vehicle.*** Any vehicle used on terrain becomes a recreational vehicle. In *Comm. v. George*, 406 Mass. 635 (1990), for example, a baseball field was not considered a public way under 90, § 24, but officers could have utilized 90B, § 26A (OUI in a recreational vehicle). Charge both offenses and let the court decide that the way is public (90, 24 applies), or it is not (90B, 26A applies). *See notes*.

Certificate of public way. G.L. c. 233, § 79F provides that a "certificate by a city or town clerk that a particular way is a public way" shall be sufficient proof. Other documents may be presented to help prove public way. *Comm. v. Hazelton*, 11 Mass. App. Ct. 899 (1980) (municipal road directory). However, *only* a certificate is sufficient proof by itself.

BAC OF .08 OR UNDER THE INFLUENCE OF ALCOHOL AND/OR DRUGS

Summary

The defendant must have a diminished capacity to safely operate because he is under the influence of: (1) alcohol; or (2) marijuana; or (3) narcotic drugs; or (4) depressants or stimulant substances; or (5) any inhalant. The offense is also proven if the defendant registers a BAC of .08 (*per se* law).

Under the Influence: Diminished ability to drive <u>or</u> BAC of .08.

- ***Not drunk, just a diminished ability.*** The purpose of this law is to protect the public from *any* driver whose alertness, judgment and ability to respond promptly have been lessened by alcohol or drugs. A motorist does not have to be drunk or even drive in an unsafe manner. The motorist merely has to have a *diminished ability* to operate safely. The amount of alcohol or drugs that cause this condition varies from person to person. *Comm. v. Connolly,* 394 Mass. 710 (1985).

- ***Officers and/or civilians may offer an opinion about a suspect's sobriety.*** However, officers may *not* say the defendant's intoxication impaired his ability to drive. This is forbidden by *Comm. v. Canty*, 466 Mass. 535 (2013). As a result:

  <u>Don't</u> testify: "Based on my training and experience, I believed John Defendant had a diminished ability to operate safely because of alcohol consumption."

  <u>Do</u> testify: "My opinion is that John Defendant was intoxicated because I smelled a strong odor of an alcoholic beverage; heard his slurred speech; saw his glassy eyes; watched him trip when he got out of his car; and saw him perform field sobriety tests." [Whatever facts you have, organize them this way. It's powerful.]

Diminished ability due to: (1) an alcoholic beverage; (2) marijuana; (3) narcotic drugs; (4) stimulants/depressants (both defined in Chapter 94C); or (5) any inhalant. One of these five substances must cause the driver to be under the influence. G.L. c. 90, § 24(1)(a).

- ***Odor, defendant's admission, or breathalyzer.*** Proof that alcohol was the intoxicating agent comes from these three sources.

- ***For drugs, be sure to classify substance under statute.*** Forgetting this technicality gives defendant an easy acquittal. *Comm. v. Ferola*, 72 Mass. App. Ct. 170 (2008) (horribly impaired defendant acquitted even though she admitted taking Klonopin to officer and nurses; prosecutor never offered proof that this drug was a depressant defined by 94C, § 1).

  Methods of proof: (1) judge relies on an authoritative source like the *Physician's Desk Reference*; (2) defendant stipulates before trial that the substance falls within the statute; or (3) expert testimony by a pharmacist or doctor. *Comm. v. Finegan,* 45 Mass. App. Ct. 921 (1998).

- ***Alcohol or drug does not have to be the sole reason for diminished capacity.*** *Comm. v. Wilson,* 2016 WL 689039 (Appeals Court) (defendant claimed he was asleep behind the wheel due to an undiagnosed sleep apnea condition, but there was also evidence he had been drinking; no need to be prove only alcohol caused his diminished capacity).

- ***Strategy for inhalants.*** OUI now covers the "fumes of any substance ... releasing toxic vapors" for "the purpose of causing ... intoxication, ... exhilaration, ... or dulled senses" as defined in 270, § 18.

- ***For legally prescribed substance, must prove that motorist had reason to know of the possible effect on his driving ability.*** *Comm. v. Reynolds*, 67 Mass. App. Ct. 215 (2006) (Melissa Reynolds struck and killed a 13 year old boy on a bike. She was under the influence of at least one of three prescriptions — Ativan, Valium and Percocet. She admitted to medical personnel that she was currently taking the drugs, but did not mention that to police. She was aware of their effects. The medications had written warnings, and her dentist cautioned her to avoid driving while taking Percocet. Reynolds also had asked her boyfriend to drive earlier that day when she "didn't feel okay"). Compare *Comm. v. Darch*, 54 Mass. App. Ct. 713 (2002) (suspect unexpectedly suffered intoxicating effects from prescription medications used as instructed; she was not guilty).

- ***Increased vigilance of drug impaired operators essential.***[1] A NHTSA study found that alcohol use by motorists has significantly diminished to 2.2%, while drug use, including marijuana, is at 16.3%.

- ***The right to possess and consume marijuana, for recreation or medical purposes, is never a legal excuse to drive OUI.*** G.L. c. 94G, § 2(a). 94I, § 7(A).

- ***Combination cases involving drugs and alcohol.*** OUI exists even if a drug magnified the effect of the alcohol or vice versa.

  - **Alcohol and illegal drugs.** *Comm. v. Stathopoulos*, 401 Mass. 453 (1986) (defendant ingested both PCP and alcohol before he drove wildly and was stopped by police). *Comm. v. Sauer,* 50 Mass. App. Ct. 299 (2000) (alcohol and five Percocets).

  - **Alcohol and legal drugs.** If the suspect *had reason to know* that her intake of alcohol and prescription medication might impair her driving, she is OUI. *Comm. v. Bishop,* 78 Mass. App. Ct. 70 (2010): Stopped by police, Lise Bishop acknowledged that she had two drinks with dinner and was taking anti-depressant medication. She said that her doctor never warned her about any side effects, and she had not read the patient information or the label. Bishop did admit that, before her arrest, she was concerned enough about the medication effects to call her doctor. Bishop was found guilty.

1 To learn more: http://www.nhtsa.gov/Impaired.

OUI CAUSING SERIOUS BODILY INJURY G.L. c. 90, § 24L(1) and (2)

Elements

There are two possible offenses depending on the driver's conduct: § 24L(1) is a felony; § 24L(2) is a misdemeanor.

- **Operation.** The suspect must operate a vehicle;
- **Public Way.** Upon a public way or in an area to which the public has a right of access as invitees or licensees;
- **Under the Influence <u>or</u> BAC of .08.** While under the influence of alcohol, marijuana, narcotics, depressants, stimulants or any inhalant; or while registering a BAC of .08;
- **Serious Bodily Injury.** The suspect must cause serious bodily injury.
    - ***For felony: Reckless or negligent.*** The offender drove recklessly or negligently which caused the required injury.
    - ***For misdemeanor: Not reckless or negligent.*** While serious injury resulted, it was not the result of the offender's reckless or negligent operation.

Penalty

For misdemeanor offense: HC NMT 2½ yrs and/or Fine NLT $3,000.

For felony offense: SP NLT 2½ yrs, NMT 5 yrs or HC NLT 6 months, NMT 2½ yrs; and Fine NMT $5,000. (Mandatory incarceration 6 months).

RMV Action for both offenses: 2 year revocation of license.

Right of Arrest

For misdemeanor offense: Citation & G.L. c. 90, § 21 warrantless arrest upon probable cause.

For felony offense: Citation & felony arrest powers.

Charging Decision

Even though defendant is involved in one accident, he should be charged separately for each person who suffers serious injury. *Comm. v. Flanagan,* 76 Mass. App. Ct. 456 (2010).

Serious Injury Defined

G.L. c. 90, § 24L(3) definition: Any injury "which creates a substantial risk of death or which involves either total disability or the loss or substantial impairment of some bodily function for a substantial period of time." [*Note:* Put hospital in police report, so medical record can be subpoenaed. G.L. c. 233, § 79. *Comm. v. McCready,* 50 Mass. App. Ct. 521 (2000).]

If Death Results from Injury

MV Homicide. G.L. c. 90, § 24G (a) and (b). *See notes.*

Manslaughter by MV (charge when death results from flagrant, reckless driving). G.L. c. 265, § 13½. *See notes.*

CHILD ENDANGERMENT WHILE OUI G.L. c. 90, § 24V

Elements

- ***OUI offense.*** The suspect violated one of the following OUI offenses: G.L. c. 90, §§ 24 (basic OUI), or 24G (motor vehicle homicide), or 24L (OUI with serious injury), or G.L. c. 265, § 13½ (manslaughter); and
- ***Child 14 or under.*** There was a child 14 years old or younger in the vehicle at the time the suspect was operating under the influence. *Comm. v. Pigo Cronin*, 2015 WL 9306688 (Appeals Court) (witnesses saw the defendant's six year old daughter in the car).

Right of Arrest

Motorist already eligible for arrest for the OUI offense.

Penalty

1st offense: HC NLT 90 days, NMT 2½ yrs; and Fine NLT $1,000, NMT $5,000 fine. **RMV action:** 1 year loss of license.

2nd offense: HC NLT 6 months, NMT 2½ yrs; or SP NLT 3 yrs, NMT 5 yrs; and Fine NMT $5,000, NLT $10,000. Mandatory 6 months incarceration. RMV action: 3 year license loss.

Mandatory condition: Any sentence must be consecutive, not concurrent with OUI.

OUI Detection & Proof

***The National Highway Traffic Safety Administration (NHTSA) identifies 3 phases in the detection of impaired drivers*:** (1) the suspect's driving behavior; (2) operator contact; and (3) sobriety testing.

PHASE 1: DRIVING BEHAVIOR

Officers should be constantly on the lookout for OUI drivers. NHTSA reports that impaired drivers are on the roads at all times, day and night, with as many as 1 in 10 under the influence between 10:00 p.m. and 2:00 a.m. on Friday and Saturday nights.

The defendant's actual operation is typically the best evidence of OUI at trial. Simple moving violations — such as running a red light — often reveal impaired motorists. Other driving behavior, even when it does not constitute a moving violation, should result in a traffic stop based on reasonable suspicion — e.g., stopping for a green light, weaving within one lane. The following behaviors have been identified by NHTSA as indicative of possible impairment:

• **Wide Radius Turns**	• **Following Too Closely**
• **Straddling Center Line**	• **Tires on Center Line**
• **Visually Appearing to be Drunk**	• **Erratic Braking**
• **Almost Striking a Vehicle/Object**	• **Driving Into Oncoming Lane**
• **Weaving**	• **Inconsistent Signaling**
• **Driving on Other than Road**	• **Slow to Respond to Signals**
• **Swerving**	• **Abrupt or Illegal Turns**
• **More than 10 mph Under Limit**	• **Abrupt or Illegal Stops**
• **Drifting Side to Side**	• **Rapid Acceleration/Deceleration**
• **Stopping Without Cause in Lane**	• **Driving Without Headlights**

A recent 911 call provides reasonable suspicion to stop a possibly impaired driver near the location where he was first observed. *Comm. v. Depiero*, 473 Mass. 450 (2016): An unidentified man reported to 911 that a "drunk driver" was "swerving all over the road." He gave the location, as well as the color, make, and license plate number of the vehicle. Dispatch determined that the vehicle owner was on probation for drunk driving. A state trooper properly stopped the car and arrested the defendant for OUI. In these cases, officers should:

- **Rely on reports from citizens.** Dispatch should learn details about the "erratic operation" and vehicle (e.g., bumper stickers, plate numbers, etc.).

- **View the possibility of an impaired driver as an "imminent danger to the public."** The quicker officers spot the suspect vehicle, the more likely a court will approve.

- **Look for any moving or equipment infractions upon seeing the suspect vehicle.** A civil infraction provides an additional reason to conduct a traffic stop.

- ***Always* stop the vehicle immediately. Don't follow to see if the operator engages in erratic driving.** This risks the possibility of a collision and may, ironically, cause reasonable suspicion to evaporate if you observe good driving. *Navarette v. California,* 134 S.Ct. 1683 (2014).

- **Check with dispatch for "collective knowledge" before writing report.** Information collected after the initial broadcast, even if it does not reach the airwaves, is still part of the reasonable suspicion calculation. For this reason, officers should include *all* information the caller furnished in their incident report.

Officer observations may provide reasonable suspicion too.

- **Before motorist gets in his vehicle.** *Comm. v. Collins*, 2011 WL 2201056 (Appeals Court) (at 9:45 p.m., Darnell Collins parked his car crookedly across two parking spaces with its back end sticking into the travel lane in the parking lot. He went into a store. When Collins returned to his car, a trooper properly detained him based on reasonable suspicion that he may have been OUI). *Williams v. Decker,* 767 F.3d 734 (2014) (bad parking job and driver drinking from a paper bag).

- **Based on an earlier encounter.** *Comm. v. Perachio*, 61 Mass. App. Ct. 591 (2004): Perachio came to the North Adams Police station to report an assault. Officer Wood noticed Perachio was "unsteady on his feet, with a flushed face, and a strong odor of alcohol [on] his breath." Officer Wood advised him not to drive. A little over an hour later, Wood saw a Volkswagen abruptly pull onto the road causing him to hit his brakes. Perachio parked and got out. Officer Wood reminded him about their earlier conversation and had him perform sobriety tests. His arrest followed.

- **Based on encounter outside of normal jurisdiction.** *Comm. v. Limone*, 460 Mass. 834 (2011) (off duty officer's vehicle struck from behind by motorist with odor of alcohol; officer did the right thing — took keys so defendant could not leave, but called local police with jurisdiction to conduct OUI investigation; local officers arrested Limone for his 7^{th} OUI!).

Sobriety checkpoints are another enforcement strategy; they <u>must</u> conform to guidelines. *Comm. v. McGeoghegan*, 389 Mass. 137 (1983).

- **4 constitutionally mandated requirements:**

  - ***No arbitrary or random stops;***

  - ***Protect public safety at location of checkpoint;***

  - ***Minimize public inconvenience;*** and

- ***Operate checkpoint in strict conformity with a written plan devised by supervisors.*** *Comm. v. Anderson*, 406 Mass. 343 (1989). *Comm. v. Baker,* 91 Mass. App. Ct. 445 (2017) (minor discrepancies with the plan — such as late arrivals, failure to sign a duty roster, and failure to file proper forms at the completion of the roadblock — do not create an unconstitutional seizure, so long as there was no discretionary departure from the policy in the field). *Comm. v. McLeod*, 2014 WL 5547923 (Appeals Court) (multi-agency checkpoints allowed; in this case, state and local police departments worked together).

- **Public notice recommended but not required.** *Comm. v. Aivano,* 81 Mass. App. Ct. 247 (2012) (press release to let public know general area and time is recommended).

- **Officers at checkpoint must refer motorists to a secondary screening area based on reasonable suspicion.** *Comm. v. Swartz,* 454 Mass. 330 (2009) discusses the proper procedure. When a motorist arrives, the initial screening officer should make a brief and courteous statement — e.g., "Good evening, this is a routine sobriety checkpoint. Sorry for the inconvenience. Goodnight."

  If the screening officer observes a sign of impairment or possible contraband, the motorist *must* be referred to a secondary area for more extensive conversation and observation (including sobriety testing). The operator should be allowed to drive to the designated area unless extremely intoxicated. *Comm. v. Bazinet,* 76 Mass. App. Ct. 908 (2010) (an odor of an alcoholic beverage, by itself, justifies referring motorist for secondary screening). Officers may only ask about alcohol consumption *after* observing a sign of impairment. *Comm. v. Angeles*, 2015 WL 8285206 (Appeals Court) (permissible to ask defendant where he had been and where he was going).

PHASE 2: OPERATOR CONTACT

Once a vehicle is stopped or officers arrive at an accident scene, officers enter the second phase of detection — personal contact with the motorist.

Request to roll down window. Officers must obtain a license and registration, and they have the right to avoid the barrier of a partially closed window. *Comm. v. O'Brien,* 2013 WL 708877 (Appeals Court): After observing Kaitlyn O'Brien's vehicle repeatedly cross onto the highway "rumble strip," a trooper pulled her over. The trooper asked O'Brien, whose window was only partially open, to roll it down completely. When she did, he smelled alcohol on her breath. This was not, as she argued, a search. Also see *Comm. v. Lobo*, 2016 WL 3486387 (Appeals Court) (reasonable suspicion of OUI where defendant drove the wrong way down a one-way street at 2:55 a.m., did not stop for police until he was boxed in, and did not open his window or place the vehicle in park and turn off the engine until instructed to do so several times).

Removal of keys. Removal of keys from the ignition is appropriate following reasonable suspicion of OUI. *Comm. v. Day,* 2017 WL 2417060 (Appeals Court).

A traffic stop does not amount to custody, so officers typically do not have to advise motorists of their Miranda rights. *Comm. v. D'Agostino*, 38 Mass. App. Ct. 206 (1995) (officer asked the driver where he was coming from; the driver replied, "I had a couple of drinks" — no *Miranda* necessary). *Comm. v. Blau*, 2017 WL 1031422 (Appeals Court) (officer asked driver how the portable BT registered the presence of alcohol when the driver said she had not consumed alcohol in years; this was a fact-finding question, not an accusation).

- **No *Miranda* custody during sobriety tests — even if following an *unarticulated* arrest decision.** *Comm. v. Becla,* 74 Mass. App. Ct. 142 (2009): Officer Steven Cecchini saw Janusz Becla maneuvering his damaged car into a driveway and asked him what happened. He responded: "Isn't it obvious I hit a pole?" Officer Cecchini later testified that, at this point, he had probable cause to arrest because Becla caused an accident and had slurred speech. Cecchini did *not* communicate this to Becla or provide him with *Miranda* warnings. Instead, he asked Becla to perform sobriety tests. He failed miserably!

  A District Court judge ruled that Officer Cecchini should have provided *Miranda* warnings once he decided to arrest Becla. The Appeals Court disagreed, declaring that a police officer's "unarticulated plan" has no bearing on whether a suspect is in custody for *Miranda*. The other features of this interaction — field sobriety tests and brief conversation — did not rise to the level of custody under *Miranda* either.

- **No *Miranda* custody for parked motorist.** *Comm. v. O'Neill*, 2015 WL 6075208 (Appeals Court): Police responded to a complaint about a minivan's erratic operation. The defendant was standing nearby in a restaurant parking lot. She was swaying. Officers asked her if she had been driving the van and if she had been drinking. She admitted to both. They asked her to perform sobriety tests, which she could not complete. The defendant was not in custody for *Miranda*. The encounter was in public, only two officers were present, and it was brief.

- **No *Miranda* custody for suspect who is restrained for medical treatment.** *Comm. v. LaFleur*, 58 Mass. App. Ct. 546 (2003): LaFleur told the EMT: "I had too much to drink." The EMT informed an officer, who then approached LaFleur, who was now strapped to a gurney. He admitted drinking too much. The officer did not provide *Miranda* warnings. The court felt medical custody is different from police custody. The questioning occurred in public with EMTs present, which diminished the possibility of police domination. The officer did not accuse LaFleur.

- **No *Miranda* custody at neutral site.** *Comm. v. Lavendier*, 79 Mass. App. Ct. 501 (2011): Police questioning occurred at the home of an acquaintance. The tone was conversational and non-accusatory. Lavendier had parked his car on the lawn and damaged the house. Although officers would not have let him leave if he tried, the test for custody is whether a reasonable person would have felt free to go — not whether the defendant was truly free to leave. Here, Lavendier never tried to leave, and officers never told him to stay. He freely admitted to being drunk.

- **No *Miranda* custody even if suspect says he wants to leave.** *Comm. v. Menelas,* 2014 WL 959661 (Appeals Court): At 2:00 a.m., Vladimir Menelas was found standing 10 yards away from a smoking vehicle by a broken telephone pole. The officer observed money and a cell phone on the driver's seat. Menelas admitted they were his. He smelled of alcohol and slurred his speech. At one point, he told the officer, "Let me leave!" His desire to leave did not change the nature of the encounter. Temporary detention at the scene is not sufficient custody for *Miranda*.

Obscenities directed at police are admissible to show intoxication. *Comm. v. Cordeiro*, 2012 WL 1108291 (Appeals Court) (when he was read his *Miranda* rights, Carlos Cordeiro said: "Fuck that, I ain't agreeing to none of that shit." Since the obscenities were evidence of his intoxication, they were admissible in court even though spoken while Cordeiro was being read his rights). *Comm. v. Mendoza*, 2015 WL 709620 (Appeals Court) (when officer asked for a license, defendant said: "Nope. I'm home. You can't make me." His flippant statement helped show he was intoxicated).

Police may search for keys and signs of injury if they have probable cause to arrest. *Comm. v. Welch*, 2012 WL 6553963 (Appeals Court): At the time Officer Byron lifted Welch's shirt and exposed a red mark on his chest and stomach, police had probable cause to arrest him for OUI and leaving the scene. The vehicle was registered to Welch at an address near the crash scene; a male driver had fled in the direction of Welch's home; and, when he answered the door, Welch had visible injuries and appeared drunk. Lifting his shirt was likely to produce further evidence of the crimes — e.g., injuries related to airbag deployment. Also see *Comm. v. Conway*, 2016 WL 3486390 (Appeals Court) (police officer conducted proper search incident to arrest for OUI in order to recover keys to the vehicle).

Investigations may occur outside — and sometimes inside — a home.

- **Based on a reasonable suspicion, police may detain a suspect in the driveway or at the door before he enters.** *Comm. v. Butterfield*, 44 Mass. App. Ct. 926 (1998) (officer was looking for a black Ford Bronco; he saw it in a driveway along with Butterfield staggering to the back door; he talked to Butterfield, then ordered him to come back and perform sobriety tests).

- **Based on probable cause of jailable misdemeanor, police may enter a home in "hot pursuit."** *Comm. v. Jewett*, 471 Mass. 624 (2015) (defendant seen driving erratically after leaving bar parking lot; he would not stop despite police lights and siren; he pulled into his driveway and ran into his house; officer properly entered and arrested him, since operating to endanger is a misdemeanor that has a potential jail sentence upon conviction).

- **However, absent hot pursuit, police may not enter without a warrant to investigate misdemeanor OUI.** *Comm. v. DiGeronimo,* 38 Mass. App. Ct. 714 (1995) forbids a warrantless intrusion into the home of a suspected drunk driver to avoid losing evidence of intoxication. The officer entered DiGeronimo's home about 45 minutes after the accident based on a report from the other driver.

- **At the same time, knocking at the door and requesting to speak with the motorist is *always* an option.** *Comm. v. Fortune*, 57 Mass. App. Ct. 923 (2003): Chicopee Police received an anonymous report that a "drunk man" had run into the curb at 30 Monroe St. An officer found a pickup truck with a flat tire. It was angled from the curb and blocking a driveway. A witness saw the driver enter 28 Monroe. A woman at #28 said that the truck belonged to the defendant, who had just arrived. He came to the door. The officer smelled alcohol, and the defendant refused to participate in sobriety testing. The officer left and applied for an OUI complaint. The tip, combined with the officer's observations, provided reasonable suspicion to conduct a threshold inquiry at 28 Monroe.

  When the officer and defendant were face-to-face, the odor of alcohol provided probable cause for OUI. The officer could have also asked the defendant to come outside to talk, and then arrested him there!

The critical equation:

Alcoholic beverage odor + slurred speech + glassy eyes = probable cause for OUI arrest

When an officer lawfully stops a vehicle and makes these three observations, probable cause exists to arrest for OUI. As a result, standardized field sobriety tests (SFSTs) are helpful, but *not* required in order to arrest a motorist. *Comm. v. Blais,* 428 Mass. 294 (1999). *Comm. v. Rarick*, 87 Mass. App. Ct. 349 (2015) (SFSTs not necessary where defendant smelled of alcohol; had red, glassy eyes; admitted consuming six beers; and was speeding).

Bottom line: Officers must remove any intoxicated motorist from the road. Officers are not required (like they are in restraining order violations) to arrest an OUI motorist. But they must, at a minimum, remove him or her from the road. *Irwin v. Ware*, 392 Mass. 745 (1983) (town liable for officers' decision to allow an intoxicated operator to drive away; his later accident caused multiple deaths; even if they choose not to arrest, police should know that permitting continued operation poses a grave risk to the public).

Preferential treatment for an impaired police officer constitutes an ethics violation. *State Ethics Commission,* Case No. 14-0006: Police received an anonymous call reporting a wrong-way driver on a highway. Responding officers from two agencies found a stopped SUV facing the wrong direction in the middle of the left travel lane. A police officer, who was on administrative leave, was sitting on the guardrail beside the vehicle. Damage on the side of her SUV indicated that she had hit the guardrail.

The officers informed their sergeant. He asked the lieutenant to come to the scene. The officers moved the SUV onto an access road for safety. The lieutenant arrived and met with the incoherent and intoxicated female officer. The lieutenant asked whether there were any charges pending against this officer and whether there were any witnesses. Officers answered "no" to both questions. The lieutenant also asked whether officers had actually observed the female officer driving. They said "no." The lieutenant asked no other questions. Instead he ordered one officer to drive the SUV to the station, and another to drive the intoxicated officer home.

- **Department policy.** The police department's policy regarding OUI states: "Appropriate enforcement action consists of immediate arrest, or if circumstances do not allow for an arrest, issuance of a citation . . . Officers should be aware that arrests should be a priority for this event." The policy also states that the department is "definitely and unequivocally opposed to preferential treatment pertaining to adjudication of traffic cases in any manner by any agency, official, or person."

- **Procedure and decision.** When the chief learned, from the lieutenant, about how the case was handled, he referred the matter to internal affairs (IA). The IA report was sent to the district attorney, who suggested that the matter be filed with the Ethics Commission. The Commission ruled that the lieutenant, as OIC, was responsible. While the responding officers were not as upfront with their observations as they should have been, the lieutenant failed to conduct any meaningful investigation. He ignored obvious evidence that the intoxicated officer operated her SUV on a public way. By failing to arrest her (or even issue a citation), the lieutenant used his position to provide her with preferential treatment — a violation of 268A, § 23. He was personally assessed a civil fine of $7,500. The reasons behind this decision clearly apply to any officer who, while on duty, discovers another, impaired officer driving under the influence.

PHASE 3: STANDARDIZED FIELD SOBRIETY TESTING

Only reasonable suspicion is necessary to order the driver to exit the vehicle and to administer Standardized Field Sobriety Tests (SFSTs). Requiring probable cause to administer SFSTs would make no sense, since the point of SFSTs is to help determine whether to arrest in the first place. *Comm. v. Eckert*, 431 Mass. 591 (2000).

- **An officer who is present during SFSTs may testify** about what the administering officer said and did. *Comm. v. Smith*, 2012 WL 6195593 (Appeals Court).

- **SFSTs may be administered in a foreign language** to a non-English speaking motorist. *Comm. v. Henriquez*, 2012 WL 4490548 (Appeals Court).

Do not automatically frisk in conjunction with an exit order for SFSTs. *Comm. v. DeAmelio*, 2016 WL 3460523 (Appeals Court): Trooper Shea stopped Peter DeAmelio for a stop sign violation. He saw a backpack on the front passenger seat with multiple prescription bottles in the outer pocket. DeAmelio's eyes were bloodshot and glassy, and his pupils were constricted. Shea asked him to exit to perform SFSTs. He frisked DeAmelio and found three small bags of crack cocaine in his chest pocket. DeAmelio admitted to having a crack pipe in the vehicle, so Shea searched the vehicle and found it. DeAmelio passed his SFSTs. The exit order was justified, but Shea needed reasonable suspicion that DeAmelio was armed and dangerous in order to frisk. There was nothing DeAmelio did to make the trooper believe he was armed.[2]

2 The better rationale for searching the driver in this case was probable cause, based on the trooper's observations, that the driver possessed drugs related to his impaired operation.

Compare *Comm. v. Bowers*, 2016 WL 7471764 (Appeals Court) (exit order and frisk during the stop were proper because it occurred on the highway at 4:00 a.m., the trooper was alone, the driver had a tattoo of a gang symbol, and the driver failed to pull over immediately and gave illogical responses regarding his destination).

Motorists may be ordered to perform SFSTs, but officers must not use physical force if they refuse and may not later testify about their refusal.[3] *Comm. v. Blais,* 428 Mass. 294 (1999). *Comm. v. Ranieri,* 65 Mass. App. Ct. 366 (2006) (even a partial refusal may not be commented on; here, defendant initially refused to recite the alphabet, and only did so when challenged by the officer). There are three exceptions:

- **Once suspect agrees to SFSTs, comments about his inability to perform are admissible.** Examples are: "I give up" or "I've had too much to drink." Since the person agreed to take the test, these statements are not the product of coercion. *Comm. v. Brown,* 83 Mass. App. Ct. 772 (2013) (on his second attempt at the one leg stand, Brown lost his balance and stated, "I can't do this").

- **Once suspect claims police did not offer SFSTs, his refusal is admissible.** *Comm. v. Beaulieu*, 79 Mass. App. Ct. 100 (2011) (defense counsel claimed that Beaulieu had not been asked to perform SFST, so officers could testify he had refused).

- **Silence not considered a refusal.** A defendant must make some expression — verbal or nonverbal — of his refusal to perform SFST. *Comm. v. Kulbeth,* 2013 WL 3834635 (Appeals Court) (trooper advised Laun Kulbeth about SFST and asked if he understood; Kulbeth nodded; when asked to perform alphabet test, he simply looked down; when asked if he was refusing to take the test, Kulbeth did not respond or react at all; trooper allowed to testify about this behavior).

Through intensive study, the National Highway Traffic & Safety Administration (NHTSA) identified 3 tests for sobriety screening — horizontal gaze nystagmus (HGN), walk and turn, and one leg stand. The NHTSA manual is the foundation for all officers around the nation! *Comm. v. Schutte,* 52 Mass. App. Ct. 796 (2001). *Comm. v. Engstrom,* 2013 WL 802196 (Appeals Court) (no need for expert witness on SFST, which measures balance, coordination, and ability to follow instructions — ordinary jurors understand that).

Review the information here, because defense attorneys often try to show that officers deviated from NHTSA procedures. At the same time, an officer's failure to follow standard practices in administering SFST does not affect the admissibility of this evidence. *Comm. v. Clemons,* 2014 WL 2131754 (Appeals Court).

3 "Refusal evidence" is typically inadmissible because it places the defendant in a Catch-22 situation: Take the test and furnish evidence against oneself, or refuse and produce testimonial evidence of consciousness of guilt, which the prosecutor can argue to the jury.

STANDARD TESTS FOR OUI ALCOHOL

WITH SOME RELEVANCE FOR BUILDING AN OUI DRUG CASE TOO

Pre-test question. When an officer begins SFST, he should ask if the motorist has any physical limitations or medical conditions that prevent performing balance and coordination tests. An officer should only score for "clues" observed during the SFST.

SFST **Horizontal Gaze Nystagmus (HGN) — *6 clues max***

TEST ADMINISTRATION BY OFFICER

Nystagmus: "An abnormal and involuntary movement of the eyeballs from side to side."

Instructions:
- Remove glasses; simply document if suspect wears contact lenses.
- Smooth pursuit: Focus on stimulus (S) moved back and forth horizontally.
- Maximum deviation: Move S horizontally to limit of field of vision.
- 45 degree: Move S horizontally and watch for nystagmus onset prior to 45 degree angle.
- Also check vertical nystagmus.

SUSPECT PERFORMANCE CLUES **4 or more clues out of 6 indicate impairment** (1 clue for each problem observed in each eye, so a maximum of 6 clues possible.)

- **Lack of smooth pursuit.**
- **Distinct and sustained HGN at maximum deviation.**
- **Onset of HGN prior to 45 degrees.**

Strong correlation between level of intoxication and the angle at which person's eyes begin to exhibit nystagmus.

Limitation on HGN in Massachusetts. Unlike many other states, the SJC has concluded that, since HGN relies on a scientific proposition, expert testimony is required. *Comm. v. Sands*, 424 Mass. 184 (1997).

However, *Sands* did not prevent officers, with expertise, from testifying about HGN [e.g., drug recognition expert (DRE) or SFST instructor].

Interestingly, the Appeals Court in *Comm. v. Hamilton*, 2007 WL 1858657 pointed out that *Sands* was decided in 1997 yet, in 2003, the American Optometric Association passed a resolution declaring HGN scientifically valid and endorsing its use by police officers. The *Hamilton* decision suggested, without squarely ruling, that officers may testify to HGN if it is not effectively rebutted by the defense attorney. Push the issue!

SFST **Walk & Turn — *8 clues max***

TEST ADMINISTRATION BY OFFICER **Instructions:**

- Listen, stand properly, do not start early, watch demonstration.
- Walk heel-to-toe on line for 9 steps.

- Conduct turn as demonstrated.
- Return 9 steps heel-to-toe along a line.

Conducting test:

- Relatively hard, dry, level, non-slippery surface.
- Observe suspect from 3 to 4 feet.
- Remain motionless.
- May use real or imaginary line.
- Ensure suspect in no danger of falling.
- Use discretion when administering test to persons over 60 years old, or 50 pounds overweight, or with physical impairments.
- Note footwear (e.g., over 2 inch heels, flip flops, etc.) Allow removal if suspect wants.
- Individuals who cannot see out of one eye may have trouble because of poor depth perception.
- Don't have motorist walk directly into the cruiser lights.

SUSPECT PERFORMANCE CLUES **2 or more clues out of the following 8 clues indicate impairment:**

- **Balance loss** during instructions.
- **Starts too soon.**
- **Stops while walking.**
- **Off line steps.**
- **Wrong number of steps.**
- **Heel-to-toe misses.**
- **Arms, raises more than 6".**
- **Turns improperly.**

Key protocol: **BS SO WHAT!**

Important note: Although suspect may step off the line 3 times, for example, only score 1 clue for each type of clue listed.

This is a *divided attention test*, which means the motorist's attention is divided into several tasks. This is a fair assessment of a person's ability to drive, since driving requires that a person perform several tasks at once (e.g., looking at the road, turning the wheel, pressing the brake or accelerator, etc.).

Comm. v. Belenkova, 2017 WL 5473603 (Appeals Court) (officer's use of the words "clue," "fail," and "pass" to describe the defendant's performance in the walk-and-turn test and the one leg stand test was permissible).

SFST **One Leg Stand — *4 clues max***

TEST ADMINISTRATION BY OFFICER **Instructions:**

- Raise one leg off the ground 6 - 8 inches and count "one one-thousand, two one-thousand . . ." until instructed to stop.
- Motorist may choose which foot.

Conducting test:

- Relatively hard, dry, level, non-slippery surface.
- Adequate lighting.
- Use discretion with persons over age 60, or 50 pounds overweight or physically impaired.
- Note footwear (e.g., over 2 inch heels, flip flops, etc.) Allow removal if suspect wants.

SUSPECT PERFORMANCE CLUES **2 or more clues out of the following 4 clues indicate impairment:**

- **Puts foot down too soon**.
- **Uses arms for balance** (raises more than 6”).
- **Sways while balancing.**
- **Hopping.**

Key protocol: **PUSH!**

Like Walk & Turn, this is a *divided attention test*. See *Comm. v. Belenkova, supra.*

SFST **Alphabet**

TEST ADMINISTRATION BY OFFICER **Instructions:**

- Request that operator recite alphabet (variation: have operator begin at the letter C and go to the letter X).

SUSPECT PERFORMANCE CLUES **No set number of clues.** Officer should note mixed letters, slurred speech, etc. *Vanhouton v. Comm.,* 424 Mass. 327 (1997) (*Miranda* unnecessary before alphabet test).

Important to add 4th test in case HGN inadmissible. Juries seem to feel that three tests are a fair assessment, unless the motorist is so intoxicated that any test runs the risk of injury. *Comm. v. Clemons,* 2014 WL 2131754 (Appeals Court) (even though alphabet test not scientifically validated, it is admissible in OUI trial as indicator of sobriety).

SFST **Preliminary Breath Test (PBT)**

SUSPECT PERFORMANCE CLUES **The Preliminary Breath Test (PBT) is recognized by NHTSA.** If officers carry a properly maintained and calibrated device, they should use it last, so the results do not prejudice their evaluation of other SFSTs. The PBT is a great training tool because it confirms the validity of the physical SFSTs, even in moderate impairment cases.

Officers *may order* a suspect to perform a PBT, since the results do not have legal consequences (unlike the “implied consent” breathalyzer at the station). However, officers should *never force* a suspect if he refuses the PBT. Judges typically do not allow PBT results into evidence during the prosecution’s case, but may allow them as rebuttal evidence if a defendant challenges an officer’s arrest decision.

SOBRIETY TESTS FOR OUI DRUGS

SFST **Lack of Convergence — *No specified clues***

TEST ADMINISTRATION BY OFFICER **Instructions:**

- Inform suspect that you will not actually touch the nose with the stimulus. [Notice is important so they will not move their head].
- Instruct them to keep their head steady and follow the stimulus with their eyes only.

Conducting test:

- Position stimulus 12-15 inches in front of subject's nose in the same position as HGN test.
- Stop stimulus 2" from bridge of nose.
- Note whether or not convergence is present and document eye movement.
- Repeat test with glasses on if operator wears corrective lenses. If operator is able to keep eyes on stimulus, there is no LOC.

SIGNIFICANT FINDINGS **Lack of Convergence (LOC)** is the inability to cross one's eyes when focusing on a stimulus as it moves towards the bridge of the nose. The following 4 drug categories will usually induce LOC:

- CNS (central nervous system) depressants (e.g., alcohol, anti-anxiety medications).
- Inhalants (e.g., volatile solvents, huffing).
- Dissociative anesthetics (e.g., PCP).
- Cannabis (e.g., marijuana, marijuana products like edibles).

SFST **Modified Romberg Balance Test — *No specified clues***

TEST ADMINISTRATION BY OFFICER **Instructions:**

- Instruct subject to stand straight with feet together and arms down at his sides.
- Tell subject to remain in position until you finish instructions.
- Emphasize that he may not start the test until you say "begin."
- Ask subject if he understands the instructions so far. [Make sure to obtain a verbal response.]
- Tell the subject to tilt his head back slightly and close his eyes.
- Tell the subject: "When you think 30 seconds have gone by, bring your head forward, open your eyes, and say 'Stop.'"

Conducting test:

- Check for presence of tremors in eyelids and body sway.
- When the subject opens his eyes, ask: "How much time was that?"
- Document his exact response.
- Record actual time elapsed.

SIGNIFICANT FINDINGS **Modified Romberg Balance Test** checks a subject's internal clock, balance and presence of tremors (eye and body).

Since the test checks for balance, ensure the test is conducted on a level surface.

Three parts are conducted simultaneously:

- Estimation of the passage of 30 seconds.
- Observation of tremors.
- Observation of sway.

Additional Observations. Observe nostrils for powder, etc. with a flashlight while suspect performs the Modified Romberg. Afterwards, have suspect stick out his tongue and check its color; have him pull his lip back to observe the teeth area for seeds, etc.

Marijuana OUI

With legal and medical marijuana available in Massachusetts, police must be vigilant for impaired drivers. While the odor of marijuana is not probable cause to search, it usually provides a reasonable suspicion that the driver is OUI. *Comm. v. Kechum,* 2015 WL 4163090 (Appeals Court) (smell of burnt marijuana, plus observation of pipe with residue, justified ordering the driver out and directing him to perform SFSTs).

- **Like any criminal investigation, police may order passengers to exit and interview them about the driver's operation.** *Comm. v. Riche,* 50 Mass. App. Ct. 830 (2001) (exit orders have a "practical purpose" to separate witnesses during field interviews).

- **If there is probable cause to arrest the driver for OUI, there is usually probable cause to search the passenger compartment for drug evidence.** In *Comm. v. Rosado,* 2014 WL 2973571 (Appeals Court), officers saw Rosado swerve toward the guardrail and straddle two lanes. They detected a strong odor of marijuana and observed his red eyes and slow speech. When asked if he had been smoking, Rosado said: "I'm just chillin'." When asked if there was marijuana in the car, he said: "If there was, I would have smoked it." He laughed a lot. A vehicle search revealed a still-smoldering joint. Outstanding job by officers! Also see *Comm. v. Daniel,* 464 Mass. 746 (2013) (under motor vehicle exception, officer could search glove box and rest of passenger compartment for marijuana once he established probable cause that the driver was OUI).

In OUI marijuana cases, SFSTs are admissible at trial as "roadside assessments" of the officer. *Comm. v. Gerhardt,* 477 Mass. 775 (2017): State Police Trooper Eric French observed a vehicle travelling without its rear lights on. French stopped the vehicle and saw smoke inside. When the window opened, he smelled burnt marijuana and saw cigar tobacco on the floor, as well as a cigar slicer on the key ring in the ignition.

He asked the driver, Thomas Gerhardt, how much marijuana was in the vehicle. Gerhardt responded that there were a "couple roaches" in the ashtray and handed two largely-consumed rolled cigarettes to French. French asked when the occupants had smoked marijuana, and one of the passengers said 20 minutes previously. Gerhardt said he had smoked about a gram of marijuana three hours before.

French asked Gerhardt to step out of the vehicle to perform standardized field sobriety tests (SFSTs). He administered the horizontal gaze nystagmus test (HGN), the nine-step walk-and-turn test (WAT), and the one-leg-stand test (OLS). French also asked Gerhardt to recite the alphabet from D to Q and count backward from 75 to 62. Gerhardt had no nystagmus indicators, and was able to recite the requested portion of the alphabet and to count backwards. He did not perform the WAT as instructed, even after several explanations and a demonstration by French. When performing the OLS test, Gerhardt put his foot down multiple times and swayed. French concluded that Gerhardt was under the influence of marijuana and issued a criminal complaint charging him with operating a motor vehicle under the influence of drugs.

- **Science of SFSTs in marijuana stops.** In considering whether a driver is operating under the influence of marijuana, no scientific agreement exists on whether (and, if so, to what extent) SFSTs are indicative of marijuana intoxication. The research findings on SFSTs as a measure of marijuana impairment are mixed. However, SFSTs still have probative value.

- **Police officers may <u>not</u> testify to the administration and results of SFSTs as they do in alcohol prosecutions, but they <u>may</u> testify to their observations as "roadside assessments."** Officers have always been able to testify about the driver's appearance and behavior. While SFSTs are not scientific evidence in marijuana stops, officers *can* testify about the defendant's performance. (To differentiate from SFSTs in OUI cases, SFSTs will be called "roadside assessments" in marijuana cases). The officer's observations are proof of a driver's balance, coordination, mental acuity, and other skills required to safely operate a motor vehicle.

- **Non-expert officers and witnesses may <u>not</u> offer an opinion that a person is "high" on marijuana.** The officer or witness cannot testify whether the driver's performance constitutes a "pass" or "fail" (like in an OUI alcohol case). SFSTs *cannot* be treated as scientific tests of impairment, so evidence of SFSTs alone cannot prove that the driver was impaired by marijuana.

  Because the effects of marijuana may vary greatly from one individual to another, and those effects are not commonly known yet, only persons qualified as an expert may offer their opinion as to whether a driver was under the influence of marijuana.

- **Still, a police officer may testify to physical characteristics of the driver,** such as bloodshot eyes, drowsiness, and lack of coordination. The officer is not permitted to offer an opinion that these characteristics mean that the driver is under the influence of marijuana.

- **Jurors may use their common sense in assessing trial evidence.** Jurors will be given instructions from the judge that "roadside assessments" are not scientific tests of marijuana impairment, and that it is up to them to decide how much weight to give the tests and whether the defendant's performance on them indicates that his or her ability to operate a motor vehicle safely was impaired.

Drug cases are challenging.

The key is to develop probable cause to arrest and search:

- Do a thorough interview. The driver will often admit ingesting drugs!
- Observe behavior and eyes — especially whether driver's pupils are dilated or constricted.
- Notice any odor (e.g., marijuana, meth, inhalants).
- Administer SFSTs as "roadside assessments," which may reveal coordination and mental clarity problems.
- Upon probable cause, search the driver and vehicle for evidence of drug impairment — e.g., marijuana, pill bottles, inhalant canisters, etc.

Consider *Comm. v. Pisano,* 2016 WL 154766 (Appeals Court): Police encountered Thomas Pisano slumped over in his car. Officer Peebles knocked on the window a few times, but Pisano did not move. When Peebles opened the door and shook Pisano to wake him up, Pisano tried to get the dog in his passenger seat to attack Peebles by yelling, "Kill, kill!"

Peebles smelled alcohol. He managed to calm Pisano down and asked him to exit. Pisano was unsteady and almost fell. He slurred his speech. He performed poorly on sobriety tests.

Peebles recovered two pill bottles from the vehicle. Pisano admitted to taking a prescription oxycodone pill and having one beer. Based on the odor of alcohol on his breath, the depth of his stupor when Peebles tried to wake him up, and the absence of 25 pills from the prescription bottle he had filled 10 hours earlier, there was ample evidence Pisano had consumed more alcohol and oxycodone than he admitted.

Utilize a Drug Recognition Expert (DRE) at the station. The DRE for a drug impaired driver is the equivalent of the breathalyzer for a drunk one! Officers can find an updated list of Massachusetts DREs at www.massdre.org.

Get additional training in Advanced Roadside Impaired Driving Enforcement (ARIDE). This two day class focuses on signs of drug impairment. It is the bridge between the basic SFST class and the in-depth DRE program.

Related Procedure

Administrative sanctions for bars, restaurants & package stores that serve intoxicated motorists. G.L. c. 138, § 69. *See Chapter 22 of LED's Criminal Law Manual.*

Post-Arrest Procedures: Booking, Testing, & Court

The booking process may provide further evidence of intoxication. *Comm. v. Grenier,* 45 Mass. App. Ct. 58 (1998) (defendant's attitude during booking helped illustrate his intoxication when he stuck out his tongue at the camera during his booking photo).

Miranda warnings and a waiver are essential if booking questions address the underlying event. *Comm. v. Sheats*, 2017 WL 1381567 (2017) (Appeals Court) (without providing *Miranda* warnings, the booking officer asked a routine suicide prevention question about whether the defendant consumed any alcohol that day; the defendant replied, "Obviously, or I wouldn't be here"; his statement was inadmissible because this question was reasonably likely to elicit an incriminating response about his OUI arrest). Compare *Comm. v. Kavanagh*, 2016 WL 6465346 (Appeals Court) (the defendant had already been read his *Miranda* rights and waived them, so the sergeant, who was completing an "OUI Arrestee Rights & Observations" form, could ask him questions during booking about the amount and type of alcohol he consumed; without *Miranda* protection, the questions and answers would have been suppressed since the defendant was under arrest at the time).

Uncooperative arrestee. If a defendant refuses to answer administrative booking questions (e.g., name, address, DOB, etc.), police may place him in a cell without a phone call, bail hearing, or breathalyzer until he cooperates. *Comm. v. Maylott*, 43 Mass. App. Ct. 516 (1997).

With reasonable cooperation, every OUI arrestee has three rights:

1st right: § 5A independent examination. Under G.L. c. 263, § 5A, a police officer must inform a person of his "right, at his request and at his expense, to be examined immediately by a physician selected by him." The arrestee must be given a copy of this law or it must be conspicuously posted. The arrestee must also be given "a reasonable opportunity to exercise [this right]." The SJC has repeatedly warned: "Strict compliance with the requirements of § 5A should be the unaltered practice." *Comm. v. Gruska,* 30 Mass. App. Ct. 940 (1991).

- **Independent exam not required for OUI drugs.** *Comm. v. Mandell*, 61 Mass. App. Ct. 526 (2004) (§ 5A is restricted to offenders charged with OUI alcohol).

- **Deaf or hearing impaired.** G.L. c. 221, § 92A requires that a deaf or hearing impaired person under arrest receive the assistance of a state-provided interpreter. *Comm. v. Kelley*, 404 Mass. 465 (1990) (hearing impaired defendant arrested for OUI did not receive proper notice of his § 5A rights because police failed to call an interpreter; his OUI case was dismissed).

- **Notify bail commissioner.** Practically speaking, a defendant will not be able to have an examination unless he is released. Police should *quickly* call the bail commissioner and report that the suspect wishes to exercise his § 5A rights, which conveys the need for a prompt hearing. *Comm. v. King,* 429 Mass. 169 (1999).

- **Police may insist that defendant complete all aspects of booking prior to obtaining an independent examination.** *Comm. v. Lively,* 30 Mass. App. Ct. 970 (1991) (when a defendant decides to take a breathalyzer and claim his right to a § 5A exam, police may require that he complete the breathalyzer first. This approach avoids stale and inaccurate results).

- **Other than notifying the bail commissioner, police have no additional obligations.** *Comm. v. Rosewarne*, 410 Mass. 53 (1991) (officer properly refused to transport defendant to a hospital, even though he arranged for a blood test there). *Comm. v. McIntyre,* 36 Mass. App. Ct. 193 (1994) (police could refuse to transport defendant to a hospital four blocks away, even though an officer was dispatched there on an unrelated matter when he requested to go).

- **Police are authorized to take protective steps (including protective custody) once an arrestee is released on bail.** *Comm. v. King*, 429 Mass. 169 (1999) instructs: "[The fact that] an arrestee must be released on bail . . . does not mean that the police must give him the keys to his vehicle and allow him to drive off if he is not in a fit condition to do so."

  Consider *Comm. v. O'Brien,* 434 Mass. 615 (2001): David O'Brien was arrested for OUI at 2:00 a.m. and booked at 2:33 a.m. O'Brien refused the breathalyzer, but wanted an independent blood test. After two unsuccessful phone calls, he was placed in a cell. At 3:30 a.m., the bail commissioner released him.

  The police told O'Brien that he had to get someone to pick him up or they would continue to hold him. He made several unsuccessful calls, stating: "Forget it, no one is going to be up now." Police placed him in protective custody at 3:41 a.m. However, they did not offer him another breathalyzer opportunity, nor did they attempt to contact the nearest detox facility. As a result, O'Brien later argued that police interfered with his effort to obtain an independent exam. The SJC disagreed.

  - ***Prompt bail hearing.*** First, there was no delay in furnishing a bail hearing, with the commissioner arriving a little over an hour after booking was completed.

  - ***Conditional release.*** The SJC approved conditioning the defendant's release on his being able to arrange a ride. Officers gave the following reasons: (1) the defendant was still intoxicated at 3:35 a.m.; (2) his home was some distance away in a neighboring town, and there was no public transportation; (3) he could not safely drive, and his car had been towed; (4) he had no way to get home other than walking alone; and (5) he had been given several opportunities to use the phone before being placed in protective custody. Under these circumstances, the requirement to arrange safe transport was "eminently reasonable . . . for the defendant's (and public's) safety."

  - ***Protective custody.*** The defendant maintained there were insufficient grounds to hold him in protective custody. However, he was incapacitated. The officers had seen significant signs of intoxication when they arrested O'Brien and, in their view, he remained intoxicated 1½ hours later when he wanted to leave alone.

    The court did criticize police for not offering O'Brien a breathalyzer and detox.[4] In the future, officers should handle the situation exactly as the police did here, except they should offer a breathalyzer because it is required under the protective custody law. While the result may be used to decide whether protective custody is proper, it may not be used to penalize the defendant under OUI law. If detox is available and desired by the defendant, police should transport him there.

2nd right: The arrestee has the right to use the phone within 1 hour of arrival at the station. G.L. c. 276, § 33A. *Comm. v. Carey*, 26 Mass. App. Ct. 339 (1988).

3rd right: OUI arrestees should receive a bail hearing within 6 hours. *Comm. v. King*, 429 Mass. 169 (1999).

4 This oversight was not fatal to the case because the police had properly documented their decision to place O'Brien in protective custody.

STATUTORY RIGHTS AND CONSENT FORM

Defendant: ____ Date: _____________________________

Case No.:____ Time: _____________________________

RIGHT TO A DOCTOR

General Laws, Ch. 263, Sec. 5A: A person held in custody at a police station or other place of detention, charged with operating a motor vehicle while under the influence of intoxicating liquor, shall have the right, at his request and at his expense, to be examined immediately by a physician selected by him. The police official in charge of such station or place of detention, or his designee, shall inform him of such right immediately upon being booked, and shall afford him a reasonable opportunity to exercise it. Such person shall, immediately upon being booked, be given a copy of this section unless such a copy is posted in the police station or other place of detention in a conspicuous place to which such person has access.

RIGHT TO A TELEPHONE

General Laws Ch. 276, Sec. 33A: The police official in charge of the station or other place of detention having a telephone wherein a person is held in custody, shall permit the use of the telephone, at the expense of the arrested person, for the purpose of allowing the arrested person to communicate with his family or friends, or to arrange for release on bail, or to engage the services of an attorney. Any such person shall be informed forthwith upon his arrival at such station or place of detention, of his right to so use the telephone, and such use shall be permitted within one hour thereafter.

REQUEST TO SUBMIT TO A CHEMICAL TEST

Pursuant to General Laws Ch. 90, Sec. 24:

1. I am requesting that you submit to a chemical test to determine your blood alcohol concentration.

2. **Drivers Age 21 or OVER:** If you refuse this test, your license or right to operate in Massachusetts shall be suspended for at least a period of 180 days or up to life for such refusal. The suspension if you take the test and fail it is 30 days.

   Drivers UNDER Age 21: If you refuse this test, your license or right to operate in Massachusetts shall be suspended for at least a period of 3 years or up to life for such refusal. The suspension if you take the test and fail it is 30 days. Drivers under age 21 will also face an **additional** suspension pursuant to General Laws Chapter 90, Section 24P of 180 days to 1 year.

3. If your blood alcohol level is .08 or above, you are in violation of Massachusetts law and may face criminal penalties. Drivers under age 21 have the same legal limit for court purposes, but will face administrative penalties for any blood alcohol concentration of .02 or above.

4. If you decide to take the test and complete it, you will have the right to a comparison blood test within a reasonable period of time at your own expense. The results of this comparison test can be used to restore your license or right to operate at a court hearing within 10 days.

5. It is not your option which type of chemical test to take. Refusal or failure to consent to take the test that I am requesting is a violation of the Implied Consent Law, and will result in your right to operate a motor vehicle being suspended as I have stated to you. Refusing this test, but requesting some other form of test is a refusal under the law.

NOTICE TO PERSONS HOLDING A COMMERCIAL DRIVER'S LICENSE

In addition to the above, Mass. General Laws Ch. 90F, Sec. 11 and 49 CFR Sec. 383.51 provide that a person **holding** a commercial driver's license who fails to submit to a required test of blood, breath, or urine, shall be disqualified from driving a commercial motor vehicle for a period of one (1) year or up to life. **This disqualification applies whether or not the person was operating a CDL vehicle.** If the vehicle was transporting 16 or more passengers, including the driver, or hazardous materials required to be placarded, the CDL disqualification shall be for three (3) years or up to life.

Do you consent to submit to the chemical test that this officer requested to determine your blood alcohol concentration?

☐ Yes ☐ No

Defendant's Signature: ____
(To be signed, or indicate why not)

Signature of Officer Before Whom the Refusal or Test Was Made: ____
(Signed)

T21202-1006

PROCEDURES FOR REFUSALS & TESTS

All motorists are deemed to have consented to the testing of their breath or blood for its alcohol content. This "implied consent" law justifies suspending an operator's license upon his refusal to allow chemical testing, or upon his failure to pass the test.

- **The Breath Alcohol Testing System (BATS) will generate the notice of suspension** based on the refusal or results of the BT. This includes administrative suspensions for those underage.

- **Officers should routinely check the arrestee's driver history (KQ) to verify the correct suspension.** If the suspension period assigned by BATS is too short, fax a BATS DATA CORRECTION form to the RMV, and the Suspension Unit will take corrective action.

- **The RMV grants authority to state and municipal police officers to destroy Massachusetts licenses confiscated for BT test refusals or failures** (including an administrative failure by someone under 21). This is the protocol, and officers should not retain the licenses unless they are evidence of another crime or somehow relevant to the OUI prosecution.

An OUI arrestee has no right to counsel before refusing or agreeing to a breath or blood test. *Comm. v. Neary-French*, 475 Mass. 167 (2016) (according to SJC, a practical problem with a right to counsel is the possibility of "stale and inaccurate" results due to delay; also, while the decision is important, it occurs before the start of court proceedings, so counsel is not required).

Because, in the author's experience, judges like it, he recommends that departments adopt this policy: "The [name of department] understands that a person under arrest for OUI has no legal right to consult with a lawyer prior to deciding whether to take the breathalyzer or blood test offered. However, upon request, the arrestee will be allowed to make one call to an attorney for immediate advice. Whether or not contact occurs, the arrestee must decide after this, at most, ten minute call so that booking is not further delayed and test results are not stale."

REFUSAL

Document refusal: G.L. c. 90, § 24(1)(f)(1)

- **Fill out RMV OUI rights form and indicate refusal.** Form must be signed by officer who received the refusal *and* a separate witness (who may or may not be an officer). *Important caution:* There is no line on form for the witness' signature, so officer must add the witness at the bottom — otherwise the suspension will be overturned!

- **Serve refusal form in-hand to defendant.**

- **Impound vehicle being driven by the operator for 12 hours.** *Note:* Irrelevant whether car belongs to offender. Whatever MV he drove is impounded with towing fee.

- **Send refusal to RMV within 24 hrs.**

Seize Mass. license & provide notice of suspension. *Never* issue a temporary license. Out-of-state license may not be confiscated; however, impound out-of-state vehicles for mandatory 12 hours.

Court presentation.

- **Evidence of refusal inadmissible in court.** *Comm. v. Wolfe*, 478 Mass. 142 (2017) (judge may only tell jurors that they cannot consider the absence of BT, blood, or SFST evidence if the *defendant* requests such an instruction).

- **Unless deliberate noncompliance.** *Comm. v. Curley,* 78 Mass. App. Ct. 163 (2010): Defendant agreed to take BT, but sabotaged test by blowing with his mouth open. Police gave him four chances. Defendant claimed he was in "diabetic shock," so police transported him to a hospital where he was overheard laughing and saying that he "pulled a fast one." Police could testify about his tricks. *Comm. v. Pearson*, 2017 WL 710304 (Appeals Court) (officer testified that the BT mouthpiece did not fog when the defendant blew into it; this was admissible because the defendant did not refuse to take the test).

- **For license suspension, deliberate defiance not required.** *Kasper v. Registrar,* 82 Mass. App. Ct. 901 (2012): At registry hearing, Kasper produced evidence that he gave a valid BT sample. However, he did not provide another one in 5 attempts. BT did not malfunction. Fact that Kasper did not provide two valid samples was enough, by itself, to constitute a BT refusal.

BREATHALYZER TEST (BT)

Document consent. *Comm. v. Davidson*, 27 Mass. App. Ct. 846 (1989) (consent only requires that BT not be *forced* on arrestee; it is not the same voluntariness standard as consent to search).

Administer test. 501 CMR 2.00.

- **Certified operator.**

- **Certified breath-testing device.** *Comm. v. Camblin*, 478 Mass. 469 (2017) (current BT machines in the Commonwealth are scientifically reliable). *Comm. v. Zeininger,* 459 Mass. 775 (2011) (BT certification report admissible without inspector's testimony). *Comm. v. Sabourin*, 48 Mass. App. Ct. 505 (2000) (may take arrestee to another station if BT malfunctions). *Comm. v. Rollins*, 65 Mass. App. Ct. 694 (2006) (operator error does not decertify the BT, and the test may be re-administered).

- **Watch arrestee at least 15 minutes.** *Comm. v. Zeininger,* 459 Mass. 775 (2011) (waiting period ensures candidate does not put anything in her mouth — e.g., food, drink, or regurgitation). *Comm. v. McKee*, 2016 WL 873012 (Appeals Court) (each subsequent test does not require a separate 15 minute observation period, as long as the suspect was continuously watched after the first test). *Comm. v. Leary*, 92 Mass. App. Ct. 332 (2017) (although it is best if one officer observes, it does not have to be the same officer watching for 15 minutes, as long as the suspect is continuously watched by police).

- **Arrestee breath samples within ± .02%.** *Comm. v. Rumery,* 78 Mass. App. Ct. 685 (2010) (only lower BT result admissible). *Comm. v. Hourican,* 85 Mass. App. Ct. 408 (2014) (.022% difference required new BT sample).

- **Calibration check between .074% and .086%.** *Comm. v. Camblin*, 471 Mass. 639 (2015) (if not, use different machine).

BT must be taken within 3 hours of operation for per se. *Comm. v. Colturi*, 448 Mass. 809 (2007) (BT may be administered beyond 3 hours for good cause — e.g., the suspect initially escaped). *Comm. v. Dacosta*, 85 Mass. App. Ct. 386 (2014).

Seize Mass. license & provide notice. *Never* issue temporary license. An out-of-state license may not be confiscated.

Comparison test. Inform suspect of right to comparison BT test at his expense. 90, § 24(e).

Use of BT results to prove either per se or impairment OUI. *Comm. v. Hubert*, 453 Mass. 1009 (2009) requires that the prosecutor offer expert testimony to explain breathalyzer results when a conviction is based solely on the "impairment" theory of OUI. On the other hand, no expert testimony is necessary when conviction rests on the *per se* theory, or when *both* theories are mentioned in the complaint (the preferred practice).

Comm. v. Filoma, 79 Mass. App. Ct. 16 (2010) ("retrograde extrapolation" scientifically proves that a suspect's blood alcohol content was greater at the time he drove than when it was measured at the police station; it must be supported by expert testimony too).

BLOOD TEST

Document consent. *Comm. v. Carson*, 72 Mass. App. Ct. 368 (2008) (test for voluntary consent to chemical test not nearly as strict as that for a *Miranda* waiver). *Comm. v. Hill*, 2015 WL 3903375 (Appeals Court) (valid consent where officer read entire form to defendant with eye injury, who then signed it). *Comm. v. AdonSoto*, 475 Mass. 497 (2016) (consent may be obtained through a language interpreter; when practical, all interviews and interrogations using an interpreter must be recorded).

Administering test. G.L. c. 90, § 24(e); 501 CMR 2.00.

- **Blood drawn by M.D, R.N, or C.M.T.** (not phlebotomist) under direction of police officer.
- **No alcohol swabs.**
- **Use gray, green, or purple stoppered tubes.**
- **2 tubes 8-10 ml.** Do not freeze. Keep cold.
- **Deliver to public safety lab for test.** Document chain of custody.

Blood test must occur within reasonable time. *Comm. v. DeJesus*, 2014 WL 1797527 (Appeals Court) (4 hours reasonable where defendant delayed going to hospital after leaving scene).

Comparison test. Inform suspect of his right to a comparison test at his expense. G.L. c. 90, § 24(e).

MOTOR VEHICLE RELEASE FORM

<u>The following motor vehicle should be released to</u>:

Name: ____

Address: ____

Date & time of tow: ______________________________________

MV make/model: ____

Plate — state/number: _____________________________________

<u>Reason for tow</u>:

- ☐ **Disabled**
- ☐ **Parking:**_____________________________________
- ☐ **Owner Request**
- ☐ **Stolen/Recovered**
- ☐ **MV Crash**
- ☐ **MV Violation:**_________________________________
- ☐ **OUI**
    - ☐ ***12 hour hold. Release <u>only</u> after ____________a.m./p.m.***
      on _________________________________(date).
    - ☐ ***May be released immediately <u>but</u> not to:***
      _________________________________ (defendant)
    - ☐ ***May be released immediately***

<u>This vehicle is currently being held by</u>:

Name of tow company: _____________________________________

Address: ____

Phone: ____

<u>This form must be presented to the tow company for release of this vehicle</u>.

Authorization: ____
Please Print Name Police ID Number

Signature: ____

Instructions: *Inform tow company that it should not release a vehicle following a police tow unless it receives this completed form. Present citizen with signed form for release.*

BLOOD TEST PROTOCOL

HOSPITAL DRAWS BLOOD FOR TREATMENT

Option 1: Safest course of action — preserve blood & get search warrant. Although hospital-tested blood is generally admissible, the best practice is for police to seize and test it.

- ***Preservation notice.*** If hospital clinicians plan to draw blood for medical treatment, officers should provide a written "preservation notice" instructing hospital staff to secure the blood pending a search warrant.[5] *See form on page 10-34.* Officers should then obtain a warrant to seize blood for testing. For a sample affidavit, go to www.ledimensions.com.

- ***Benefits of approach.*** First, only a police-sponsored blood test results in a defendant's license suspension. The registry will not suspend based on a hospital blood test. Second, some hospital tests are inadmissible. An independent test avoids this pitfall.

Option 2: Have prosecutor subpoena hospital record. If hospital clinicians plan to draw blood, officers may decide to simply notify the prosecutor — who may then subpoena the medical records as proof in the OUI case. *Comm. v. Ackerman*, 476 Mass. 1033 (2017) (defendant's hospital blood test and staff observations in her record admissible at OUI trial). *Comm. v. Finnegan*, 2015 WL 522770 (Appeals Court) (even victim's medical record is admissible to prove OUI). *Comm. v. Palacios*, 90 Mass. App. Ct. 722 (2016) (ambulance records also admissible).

- ***Defendant's refusal to submit to hospital-administered blood test admissible.*** *Comm. v. Arruda*, 73 Mass. App. Ct. 901 (2008) (if a blood test is recommended by a clinician to treat the defendant, his refusal to allow the procedure may be offered into evidence against him; evidence of this refusal is not covered by the right against self-incrimination because it does not result from law enforcement interrogation).

- ***Be sure to ask hospital staff if they are doing a "rapid urine screen," since it is inadmissible.*** *Comm. v. Johnson,* 59 Mass. App. Ct. 164 (2003): Daniel Johnson drove off the highway. The arresting trooper found cocaine in the car. The hospital administered a "rapid urine screen" showing cocaine. However, the record stated: "This test is a rapid screening system for drugs . . . A second method must be used to obtain a confirmed analytical result." Consequently, these test results were inadmissible at Johnson's trial.

HOSPITAL DOES NOT DRAW BLOOD FOR TREATMENT

Option 3: Implied consent law covers breath or blood test. Under 90, § 24(e), an OUI arrestee is deemed to consent to a "chemical test or analysis of breath." In fact, the consent form (*page 10-27* states: "It is not your option which type of chemical test to take. Refusal . . . to take the test that I am requesting is a violation of the implied consent law."

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5 If the notice is verbal, be sure to note the name and position of the staff member in the incident report.

- ***Police-initiated.*** If drawing blood is not part of the treatment plan, or if hospital personnel only plan to do a "rapid urine screen," then officers should initiate the implied consent blood test because a breathalyzer (BT) is unavailable. Remember, an OUI arrest triggers the authority of officers to direct the hospital to draw blood. The hospital must follow procedures outlined in 90, § 24(e) and 501 CMR 2.00 (*page 10-30*). Police must take custody of the sample and deliver it to the state laboratory. If the arrestee declines to provide blood, officers should document his refusal on their station BT so the RMV is aware.

- ***Communicate that drawn blood will be used for both alcohol and drug testing.*** *Comm. v. Sheppard*, 2014 WL 537479 (Appeals Court) (following a fatal crash, the trooper wisely made it clear to Jacob Sheppard that he was consenting to a test for blood alcohol *and* narcotics levels; this is important because the rights form only talks about blood alcohol).

- ***Release from custody.*** Once the arrestee refuses or provides blood, an OIC can have the bail commissioner respond to the hospital and release the arrestee. Now the hospital is responsible for holding or releasing him, just like any other patient.

Option 4: Obtain search warrant ordering hospital to draw blood. Officers should never assume that exigent circumstances will justify having blood drawn for investigative purposes. *Missouri v. McNeely*, 133 S. Ct. 1552 (2013): Tyler McNeely was stopped for speeding and crossing over the center line in Missouri. After declining to take a breath test, he was arrested and taken to the hospital for blood testing. The officer never attempted to obtain a search warrant. Despite McNeely's refusal, the officer directed the lab technician to take a sample. This was a routine OUI investigation, and apart from the fact that McNeely's blood alcohol level was decreasing, there were no emergency circumstances.

The U.S. Supreme Court ruled that the natural metabolism of alcohol in the bloodstream does not create an automatic exigency. Instead, exigency must be determined on a case-by-case basis. The Supreme Court reasoned that a person's blood alcohol content (BAC) naturally dissipates in a gradual and relatively predictable manner and, since an officer typically takes an OUI suspect to a medical facility to conduct the test, some delay between the arrest and the test is inevitable. The court also noted that advances in recent years have allowed for faster processing of warrant applications, particularly in drunk driving investigations.

McNeely gave only one example of an exigency — an officer being so delayed in his investigation and transport of an injured suspect that he truly lacked the time to get a warrant for a blood sample.

Commentary: This Supreme Court decision should not affect the Massachusetts implied consent law. Under implied consent, the motorist may refuse a breath or blood test and suffer the license suspension consequences.

Missouri v. McNeely was different because the defendant did refuse, and the officer took his blood at the hospital anyway. If you are going to draw blood for investigative purposes without the defendant's consent, get a search warrant, unless you can make the case for exigent circumstances.

PRESERVATION NOTICE

The individual named below is the subject of an ongoing **criminal investigation** conducted by the

____ [name of Police Dept.]

As part of this criminal investigation, it is hereby requested that **any blood and/or urine samples** taken from:

____ [name of patient]

_______/______/__________ [patient's DOB] who was treated on

____ [list applicable date(s)]

at the __________________________________ [list health care institution]

be preserved pending the issuance of a search warrant.

________________________________ [print investigator's name, rank & ID]

_____________________________ [signature] _________________ [date]

If you need further information, please call_________________ [Dept. phone number] and ask the dispatcher to immediately contact me. A return call will be made without delay.

Important note: Failure to abide by this notice may constitute the crime of Evidence Tampering or Destruction, in violation of G.L. c. 268, § 13E, which is punishable by up to 10 years in state prison.

To the investigator: Record, in your police incident report and your search warrant affidavit, the name of the health care or administrative professional who received this notice.

OUI CONSEQUENCES

CHEMICAL TEST REFUSALS

UNDER 18

- ***No prior OUI:*** 3 year suspension + 1 year *or* 180 days under 24P
- ***1 prior:*** 3 year suspension + 1 year under 24P
- ***2 priors:*** 5 year suspension + 1 year under 24P
- ***3 or more:*** Lifetime suspension

G.L. c. 90, § 24P requires, in addition to the periods of suspension mandated above, that the youthful offender receive an additional 1 year suspension. This additional suspension may be reduced to 180 days upon entry into a Department of Public Health (DPH) program, provided this is the youth's 1st OUI. This reduction is designed to encourage youths to undergo alcohol education *regardless* of the outcome of their case.

License seized after refusal.

18 BUT UNDER 21

- ***No prior OUI:*** 3 year suspension + 180 days *or* no days under 24P
- ***1 prior:*** 3 year suspension + 180 days under 24P
- ***2 priors:*** 5 year suspension + 180 days under 24P
- ***3 or more:*** Lifetime suspension

G.L. c. 90, § 24P requires, in addition to the periods of suspension mandated above, that the youthful offender receive an additional 180 day suspension. This 180 day suspension may be waived upon entry into a DPH program, provided this is the youth's 1st OUI. This exemption is designed to encourage youths to undergo alcohol education *regardless* of the outcome of their OUI case.

License seized after refusal.

21 OR OLDER

- ***No prior OUI:*** 180 days
- ***1 prior:*** 3 year suspension
- ***2 priors:*** 5 year suspension
- ***3 or more:*** Lifetime suspension

License seized after refusal.

CDL

Out-of-Service Order (OSO) for 24 hrs. CDL suspended for 1 yr; 3 yrs. if hazardous materials; life if 2nd CDL offense. G.L. c. 90F, § 10 and § 11.

License seized after refusal.

CHEMICAL TEST RESULTS

UNDER 18

TEST READING .02, .03, .04, .05

ADMINISTRATIVE CONSEQUENCES ***Administrative 1 year license suspension (established by G.L. c. 90, § 24P). License seized. No temporary license. Driver released forthwith.*** The 1 year suspension may be reduced to 180 days upon entry into a DPH program, provided this is a 1st offense. This additional suspension is designed to encourage youths charged with OUI to undergo alcohol education *regardless* of their court case outcome.

TEST READING .06 and .07

ADMINISTRATIVE CONSEQUENCES ***No permissible inference. Driver held. License seized.*** Same administrative consequences as above.

TEST READING .08 or above

ADMINISTRATIVE CONSEQUENCES ***Permissible inference OUI. Driver held. License seized. No temporary license.*** 30 day suspension *plus* administrative 1 year license suspension (established by G.L. c. 90, § 24P). The 1 year suspension may be reduced to 180 days upon entry into a DPH program, provided this is a 1st offense. This additional suspension is designed to encourage youths charged with OUI to undergo alcohol education *regardless* of their court case outcome.

18 BUT UNDER 21

TEST READING .02, .03, .04, .05

ADMINISTRATIVE CONSEQUENCES ***Administrative 180 day license suspension. License seized. No temporary license.*** Driver released forthwith. The 180 day suspension may be waived upon entry into a DPH program, provided this is a 1st offense. This additional suspension is designed to encourage youths charged with OUI to undergo alcohol education *regardless* of their court case outcome.

TEST READING .06 and .07

ADMINISTRATIVE CONSEQUENCES ***No permissible inference. Driver held. License seized.*** Same administrative consequences as above.

TEST READING .08 or above

ADMINISTRATIVE CONSEQUENCES ***Permissible inference OUI. Driver held. License seized. No temporary license.*** 30 day suspension *plus* administrative 180 day license suspension (established by G.L. c. 90, § 24P). The 180 day suspension may be waived upon entry into a DPH program, provided this is a 1st offense. This additional suspension is designed to encourage youths charged with OUI to undergo alcohol education *regardless* of their court case outcome.

21 OR OLDER

TEST READING.02, .03, .04 and .05

ADMINISTRATIVE CONSEQUENCES ***Permissible inference not OUI. Released forthwith. License not seized.*** No police liability for false arrest if officer had "reasonable grounds" to believe suspect was OUI.

TEST READING .06 & .07

ADMINISTRATIVE CONSEQUENCES ***No permissible inference. Driver held. License not seized.***

TEST READING .08 or above

ADMINISTRATIVE CONSEQUENCES ***Permissible inference OUI. Driver held. License seized. No temporary license.*** 30 day suspension or until the conclusion of the case, whichever is *shorter.*

CDL [See G.L. c. 90F, § 10 and § 11]

TEST READING Any amount

ADMINISTRATIVE CONSEQUENCES ***Out-of-Service Order (OSO) for 24 hours. Driver released forthwith.***

TEST READING Below .04

ADMINISTRATIVE CONSEQUENCES ***OSO for 24 hours. Driver released forthwith.***

TEST READING .04 and .05

ADMINISTRATIVE CONSEQUENCES ***OSO for 24 hours. Driver released forthwith.*** CDL suspended for 1 year; 3 yrs if hazardous materials; life if 2^{nd} CDL offense.

TEST READING Above .05

ADMINISTRATIVE CONSEQUENCES ***OSO for 24 hours. Driver held.*** CDL suspended for 1 year; 3 yrs if hazardous materials; life if 2^{nd} CDL offense.

OUI CONVICTIONS

Offense Number	Incarceration & Fines*	RMV Conviction Sanctions
1	*Regular disposition:* HC NMT 2½ yrs and/or Fine NLT $500, NMT $5,000. [also may impose community service]	1 year revocation of license. Hardship: Work/education possible in 3 months, general in 6 months. Reinstatement fee $500.
	§ 24D alternative disposition: 2 yrs probation and DPH Alcohol Program. However, offenders age 16 to 21 must do 14 days of residential treatment if BAC .20 or greater.	Suspension of license NLT 45 days, NMT 90 days. If under 21, suspension for 210 days. Hardship: General possible in 3 days. Reinstatement fee $300.
2	*Regular disposition:* HC NLT 60 days, NMT 2½ yrs [Mandatory: 30 days]; and Fine NLT $600, NMT $10,000.	2 year revocation of license. Hardship: Work/education possible in 1 year, general in 18 months. Ignition interlock device. Reinstatement fee $700.
	§ 24(b)(4) alternative disposition: 2 yrs probation and 14 days in DPH residential treatment with follow-up outpatient.	Same as above.
	§ 24D alternative available if prior conviction over 10 years old. 2 yrs probation and DPH Alcohol Program. *Comm. v. Cahill*, 442 Mass. 127 (2004).	Same as 24D for 1st offense above, but add Ignition interlock device.
3	SP NLT 2½, NMT 5 yrs, or HC NLT 180 days, NMT 2½ yrs [Mandatory: 150 days]; and Fine NLT $1,000, NMT $15,000.	8 year revocation of license. Hardship: Work/education possible in 2 yrs, general in 4 yrs. Ignition interlock device. Reinstatement fee $1,200
4	SP NLT 2½ yrs, NMT 5 yrs or HC NLT 2 yrs, NMT 2½ yrs [Mandatory: 1 year]; and Fine NLT $1,500, NMT $25,000.	10 year revocation of license. Hardship: Work/education possible in 5 yrs, general in 8 yrs. Ignition interlock device. Vehicle forfeiture. G.L. c. 90, § 24W
5	SP NLT 2½, NMT 5 yrs or HC NLT 2½ yrs [Mandatory: 2 yrs]; and Fine NLT $2,000, NMT $50,000.	Lifetime revocation of license. Hardship: None. Vehicle forfeiture. G.L. c. 90, § 24W

6	SP NLT 2½ yrs, NMT 5 yrs [Mandatory 2 yrs] and Fine NLT $2,000, NMT $50,000; or HC NLT 2½ yrs [Mandatory 2 yrs] and Fine NLT $2,000, NMT $50,000.	Lifetime revocation of license. Hardship: None. Vehicle forfeiture. G.L. c. 90, § 24W
7	SP NLT 3½ yrs, NMT 8 yrs [Mandatory 3 yrs] and Fine NLT $2,000, NMT $50,000.	Lifetime revocation of license. Hardship: None. Vehicle forfeiture. G.L. c. 90, § 24W
8	SP NLT 3½ yrs, NMT 8 yrs [Mandatory 3 yrs] and Fine NLT $2,000, NMT $50,000.	Lifetime revocation of license. Hardship: None. Vehicle forfeiture. G.L. c. 90, § 24W
9 *or more!*	SP NLT 4½ yrs, NMT 10 yrs [Mandatory 4 yrs] and Fine NLT $2,000, NMT $50,000.	Lifetime revocation of license. Hardship: None. Vehicle forfeiture. G.L. c. 90, § 24W

* For all OUI offenses, there is a $250 surfine to the Head Injury Trust Fund plus a $50 surfine to the Drunk Driving Victims' Trust Fund. These fines are non-waivable.

Definition of Prior Offense — *G.L. c. 90, § 24(1)(a)*

No time limit. Any person who has *ever* been convicted and/or assigned to an alcohol treatment program, *in any state*, is a subsequent offender. Conviction, CWOF or assignment on the prior offense must occur *before* the commission of the subsequent offense. *Comm. v. Flaherty*, 61 Mass. App. Ct. 776 (2004) (prior New Hampshire conviction). *Comm. v. Valiton,* 432 Mass. 647 (2000) (prior juvenile delinquency finding).

No unilateral reduction of OUI. *Comm. v. Rose,* 54 Mass. App. Ct. 919 (2002) (over objection, judge should *not* have allowed defendant to plead guilty to 3rd OUI because prosecutor prepared to prove 4th offense).

Proof of prior offense. Certified court and/or probation records. G.L. c. 90, § 24(4), and/or suspect's admission (so it makes sense to interview the suspect and confirm his prior history after his arrest). A live witness need not be present in court; however, the prior offense record must be clearly linked to the defendant. Name and birth date, without more, is insufficient to prove that the defendant is the same person who committed the prior OUI. More identifying features are required, such as prior addresses or photographs. *Comm. v. Cruz,* 2013 WL 3233462 (Appeals Court). *Comm. v. Ellis*, 79 Mass. App. Ct. 330 (2011) (certified conviction and RMV documents are admissible as business records; probation records are not because they are prepared for trial).

Notes

Pretrial detention only available for 4th offense or more. *Comm. v. Dayton*, 477 Mass. 224 (2017) (276, § 58A requires three convictions before defendant can be detained without bail).

Registry action not bound by lenient court sentence. *Luk v. Comm.*, 421 Mass. 415 (1995) (even though judge sentenced defendant as a first offender, it was really her 2nd OUI; as a result, the registrar properly suspended her license for two years, which is the normal suspension associated with 2nd offenders).

CWOF not available after a jury verdict. *Comm. v. LeRoy*, 376 Mass. 243 (1987).

Judges have discretion whether to dismiss or issue a CWOF for a qualified veteran or active duty service member's subsequent offense. The VALOR Act provides pretrial diversion to young veterans and active duty members of the armed forces facing criminal charges in the District and Boston Municipal Courts. This law gives judge discretion to order either a dismissal or a CWOF in cases involving OUI, second or subsequent offense. *Comm. v. Morgan*, 476 Mass. 768 (2017).

IGNITION INTERLOCK DEVICES

Definition. A certified ignition interlock device is "an alcohol breath screening device that prevents a vehicle from starting if it detects a blood alcohol concentration over a preset limit of .02 or 20 mg of alcohol per 100 ml of blood." G.L. c. 90, § 24S.

Reason for installation. Any 2nd or subsequent OUI offenders must have "ignition interlock devices" installed on any cars they own, lease or operate (including their employer's vehicle) during the time they have a hardship license *and* for an additional 2 years following the reinstatement of their license.

"Z" restriction on license. A "Z" restriction appears on the license. G.L. c. 90, § 24.

CRIMINAL OFFENSE ***Driving on a public way without an ignition interlock device when required by law.*** Defendant must have a valid license to be charged with this. *Comm. v. Petit,* 83 Mass. App. Ct. 401 (2013) (because his license had previously been revoked for removing his interlock device, Petit could not be convicted of operating in violation of this restriction! Police should simply charge operating on a suspended license.

STATUTE & ARREST G.L. c. 90, § 24S; Felony

PENALTY SP NLT 2½ yrs, NMT 5 yrs or HC NLT 180 days, NMT 2½ yrs; and Fine NLT $1,000, NMT $15,000. Mandatory minimum of 150 days.

CRIMINAL OFFENSE ***Tampering or interfering with an ignition interlock device with the intent to disable the device***

STATUTE & ARREST G.L. c. 90, § 24T; Felony

PENALTY SP NLT 3, NMT 5 yrs or HC NLT 6 months, NMT 2½ yrs.

CRIMINAL OFFENSE ***Knowingly breathing into or starting an ignition interlock device for a restricted person.*** *See notes section below.*

STATUTE & ARREST G.L. c. 90, § 24U; Complaint

PENALTY *1st offense:* HC NLT 6 months, NMT 2½ yrs; or Fine NLT $1,000, NMT $5,000. *2nd or more:* SP NLT 3 yrs, NMT 5 yrs.

CRIMINAL OFFENSE ***Knowingly permitting an operator (with an interlock restriction license) to operate a motor vehicle owned by suspect or under his control that does not have a functioning device.*** *See detailed breakdown in Chapter 4.*

STATUTE & ARREST G.L. c. 90, § 12; Complaint

PENALTY *1st offense:* HC NMT 1 year and Fine NMT $500. *2nd offense:* HC NMT 2½ yrs and/or Fine NMT $1,000.

RMV: Suspend registration and/or license of motorist for NMT 1 year.

ADMINISTRATIVE VIOLATION ***Failing an initial test or missing a rolling re-test***

STATUTE/REGS G.L. c. 90, § 24 gives RMV general authority. Specific guidelines for program in 540 CMR 25.01 to 25.14

REGISTRY CONSEQUENCES Lockout. Driver must see vendor within 48 hours. Report to RMV.

ADMINISTRATIVE VIOLATION ***Miss monthly service visit***

STATUTE/REGS G.L. c. 90, § 24 gives RMV general authority. Specific guidelines for program in 540 CMR 25.01 to 25.14

REGISTRY CONSEQUENCES Lockout.

ADMINISTRATIVE VIOLATION ***Miscellaneous violations***

- Operating without device; or
- Allowing another to blow into the device; or
- Tampering or "circumventing" the device; or
- Failing a rolling re-test with BAC at least .05, or failing two with BAC between .02 & .05; or
- Two lockouts due to missed rolling re-tests; or
- Two missed service visits.

STATUTE/REGS G.L. c. 90, § 24 gives RMV general authority. Specific guidelines for program in 540 CMR 25.01 to 25.14

REGISTRY CONSEQUENCES Revocation of hardship license and additional 10 year license revocation. If license already reinstated, revocation for 10 yrs.

2 failed rolling re-tests: Revocation for life.

Note: Offenders may appeal their revocation to the superior court.

Notes

Acknowledgement by household members. As a precondition to issuing any ignition device, the RMV requires that all licensed operators in the offender's household sign an acknowledgement (under penalty of perjury) that they understand that the offender may not drive without a device and that it is a crime to breathe into a device for the offender. This acknowledgement "shall be admissible in a [G.L. c. 90, § 24U] prosecution" as sufficient evidence of the signer's knowledge.

Related Offense

Leasing Motor Vehicle, Trailer, or Motorcycle to Intoxicated Person. G.L. c. 90, §§ 32C and 32H. Penalty: HC NLT 30 days, NMT 6 months; and/or Fine NLT $25, NMT $250. Right of Arrest: Complaint.

Other Alcohol/Marijuana Vehicle Offenses

OPEN CONTAINER
90, § 24I (Alcohol) & 94G, § 13(d) (Marijuana)

Summary

Known as "open container," §§ 24I and 13(d) apply to both drivers and passengers, even if the car is not being operated at the time of the infraction. Thus, a person sitting in a car with an open beer or open container of marijuana is in violation. Of course, if any drivers or passengers are under 21, then other possession laws apply. The $500 fine is a stiff one!

Elements

- **Anyone.** Drivers, passengers, or anyone else;
- **Possessed open container of alcohol or marijuana.** Possessed an open container of an alcoholic beverage or marijuana;
- **Passenger area.** In the passenger area of any motor vehicle;
- **Public way.** On a public way. [Apply exact same definition for public way as OUI.]

Enforcement & Penalties

Under 90, § 24I, an open container of alcohol is enforced by a $505 CMVI. Officers should issue a citation to the driver and/or passengers involved. Furthermore, 90, § 24P mandates an additional 180 day suspension for a driver under 18. 1 year for any subsequent offense.

Under 94G, § 13(d), marijuana is enforced by a $500 local ticket. Unlike alcohol, an open container of marijuana is not enforced by a vehicle citation. Instead, officers must assess the fine on a bylaw or ordinance ticket in the same way they enforce other civil fines for marijuana violations under Chapter 94G. See G.L. c. 94G, § 13(g).

Definitions

Open container: Under § 24I: "Any bottle, can or other receptacle used to contain an alcoholic beverage that has been opened or has a broken seal, or the contents of which have been partially removed or consumed." Under § 13(d): "Open container" means "the package containing marijuana or marijuana products ha[d] its seal broken or [some] contents . . . partially removed or consumed."

Passenger area: The passenger compartment for both offenses does not include the trunk, locked glove box, or the living quarters of a mobile home. If the vehicle does not have a trunk, then the area behind the last upright seat is not considered the passenger compartment. Finally, people may drink alcohol on a bus or other vehicle that has been properly licensed for that purpose. There is no license (yet) for marijuana use in a mobile vehicle.

Notes

Traffic stops may be based on marijuana odor, smoke, or visible use. While *Comm. v. Rodriguez*, 472 Mass. 767 (2015) held that the odor of burnt marijuana was an insufficient reason to conduct a traffic stop, it was decided before the law changed to specifically prohibit an "open container" of marijuana in a vehicle under 94G, § 13(d).

Clearly, officers have a reasonable suspicion to stop a vehicle for "open container" when they smell the odor of marijuana coming from a passing vehicle, or smell it and observe smoke, or see an occupant engaged in likely consumption (e.g., holding a bong or joint). Applying the "reasonable suspicion" standard makes sense because the law, at the time *Rodriguez* was decided, did not differentiate between possession outside or inside a vehicle. This led the SJC to conclude that the higher standard of probable cause was necessary since vehicle stops to investigate marijuana were not linked to highway safety. The passage of 13(d) — an open container law with a high fine — is proof that highway safety is, in fact, compromised whenever marijuana is present and accessible in a vehicle.

Officers may consider virtually any container as "open." According to 13(d), an "open container" is any "package containing marijuana or marijuana products that has its seal broken or [some] contents . . . partially removed or consumed." Once its seal breaks, a package may not be in the passenger compartment. This restriction covers any homemade container. After all, any ziplock bag has its seal broken when the product is stored in the bag. The same is true for a Tupperware container or a mason jar. The only package that would not have its seal broken is one originally sold by a marijuana business that remains unopened. These packages are sold by medical marijuana dispensaries and, in the future, will be sold by marijuana businesses licensed by the Cannabis Control Commission. Since retail packaging is highly unusual, at least at this time in Massachusetts, the vast majority of containers located in the passenger compartment may be considered "open." Certainly, a marijuana "joint" or cigarette is an "open" container under this definition.

It is recommended that officers apply this important public safety law broadly to include marijuana cigarettes or any other marijuana product that has been at least "partially consumed" or is in a container where the seal has been broken.

MINOR POSSESSING OR TRANSPORTING G.L. c. 138, § 34C

Elements

- **Under 21.** The suspect was under 21 years of age *and* unaccompanied by a parent or legal guardian; and
- **Possess or transport.** Knowingly possessed, transported, or carried on his person;
- **Alcohol.** Any alcoholic beverage or alcohol (e.g., whipped cream with alcohol, etc.).

Right of Arrest & Exemption

G.L. c. 138, § 34C warrantless arrest in presence. However, § 34C does not apply to people between age 18 and 21 who carry or transport alcohol during the course of their employment.

Penalty

1st offense: Fine NMT $50; ***2nd or subsequent offense:*** Fine NMT $150.

Mandatory Registry Action: 90 day suspension applies to all violators, regardless of whether they were driving at the time of the violation.

Constructive Possession

Comm. v. Petersen, 67 Mass. App. Ct. 49 (2006) states that possession may be *constructive*. Here, the 20 year old defendant smashed his car in his neighbor's yard. He was later arrested when he came back to the scene. An inventory of the vehicle revealed whiskey and beer bottles in the front. Aside from OUI and leaving the scene, he was convicted of being a minor in possession — even though no one saw him drinking or holding alcohol.

UNLAWFUL TRANSPORTATION OF ALCOHOL G.L. c. 138, § 22

Elements

- ***Regular citizens.*** A citizen may, "but only for his own use and that of his family and guests," transport at any one time without a permit, the following maximum quantities: 20 gallons of malt beverages; 3 gallons of any other alcoholic beverages; or 1 gallon of alcohol.

  Exception: "[A]ny person may, without any license or permit, transport from his place of residence to a new place of residence . . . alcoholic beverages manufactured by him for his own private use."

- ***Licensees who sell alcohol.*** Any licensee or employee may transport and deliver alcoholic beverages, bought or sold by the licensee, anywhere in the Commonwealth. Each vehicle must be covered by a permit from the Alcoholic Beverages Control Commission (ABCC).

- ***Salesmen.*** A salesman licensed under G.L. c. 138, § 19A may transport samples of up to 24 gallons of alcohol or alcoholic beverages, provided he possesses a § 19A permit, invoices and delivery records.

- ***Retail wine or beer delivery.*** A winery or brewer licensed under G.L. c. 138, §§ 19B, 19C or 19F may use a parcel service or trucking business, with an ABCC permit, to deliver wine or beer to customers not in excess of 108 liters per shipment. A delivery receipt must contain certification from the recipient that he is at least 21 and from the delivery person that he observed valid ID.

- ***Caterers.*** A caterer may obtain a 12C license and transport and store alcohol on behalf of its customers.

Proof of Violation

G.L. c. 138, § 22 mandates that every motorist transporting alcohol carry a vehicle permit or certified copy or be exempt. The driver must produce documentation upon request of any police officer or ABCC investigator. Failure to do so is *sufficient evidence* of a violation. *Comm. v. Dzewiacin*, 252 Mass. 126 (1925) (absence of permit sufficient, no *intent* required).

Helpful conversion figures. 20 gallons is 2,560 ounces (oz), so officers can do the math with 10, 12 or 20 oz bottles or cans. For example, eight 30-packs of 12 oz bottles = 2,880 oz of beer. Nine 24-packs of 12 oz cans = 2,592 oz of beer. Both violations! Also, domestic beer comes in 15.5 gallon ½ kegs (no one sells full kegs). Imported ½ kegs are 13.5 gallons. This is helpful information, especially in college communities!

With respect to wine and liquor, 3 U.S. gallons equals 11.3 liters. [conversion charts appear on Google.] A typical bottle of wine is 1 liter, so 12 bottles of wine is outside the citizen exemption under § 22.

Right of Arrest

G.L. c. 138, § 56 warrantless arrest in presence.

Penalty

HC NMT 6 months; and/or Fine $2,500.

Administrative Action: ABCC may revoke any existing transportation permit.

Related Offense

No Hawking or Peddling Alcoholic Beverages. As a result of G.L. c. 138, § 32, no license or permit holder may, by himself or through an agent, travel from "place to place" selling or peddling any alcoholic beverages from a vehicle. All sales must take place at "the licensed place of business." Penalty: HC NMT 6 months; and/or Fine NMT $200. Right of Arrest: G.L. c. 138, § 56 warrantless arrest in presence.

Horizontal Gaze Nystagmus (4 of 6)

	YES	NO
Wearing Contacts	☐	☐
Left Eye 1st 12" – 15"	☐	☐
Equal Tracking	☐	☐

	LEFT	RIGHT
Lack of Smooth Pursuit	☐	☐
Distinct and Sustained Nystagmus at Maximum Deviation	☐	☐
Onset of Nystagmus Prior to 45°	☐	☐

Walk & Turn (2 of 8)

Phase I: *Instruction Stage: Right in Front of Left*

(Reminder: BS SO WHAT) (Feet Break Apart)

	YES	NO
Balance	☐	☐
Starts too Soon	☐	☐

Phase II: *Walking Stage*

	1st 9 Steps	2nd 9 Steps
Stops While Walking	☐	☐
Off Line	☐	☐
Wrong Number of Steps	☐	☐
Heel-to-Toe, Misses > ½"	☐	☐
Arms, Raises >6"	☐	☐
Turns, Improper	☐	☐

One Leg Stand (2 of 4)

(Reminder: PUSH)

	YES	NO
Puts Foot Down	☐	☐
Uses Arms for Balance >6"	☐	☐
Sways While Balancing	☐	☐
Hopping	☐	☐

Additional Observations

Alphabet "A" to "Z"

DOB by Month/Year Only

What's Your Middle Name?

Preliminary Breathalyzer Test (PBT)

Time ______ Serial #_____________ Test # ___________ Result___________

John Sofis Scheft, Esq.
Law Enforcement Dimensions, LLC

Policing with Perspective

Immediately Necessary OUI Reforms

- **No requirement of "public way"** (contributes nothing to public safety). OUI should simply require operation that is under the influence.
- **Clear statement that motorists are obligated to lower window and perform sobriety tests on side of road, include in 90, § 25.** See *Comm. v. Blais,* 428 Mass. 294 (1999) and *Comm. v. O'Brien,* 2013 WL 708877 (Appeals Court).
- **Drug Recognition Experts (DREs):**
  Should be uniformly recognized by commonwealth courts; and
  Have penalty for refusal to submit to blood, breath or DRE 12 step process.
- **Repeal 94G, § 13(g) and insert authorization to write marijuana civil offenses on 90C citation, especially "open container."**
- **Amend 276, § 1 to authorize searches for evidence related to civil marijuana infractions** [overruling *Comm. v. Cruz,* 459 Mass. 459 (2011)].

Drug Recognition Expert (DRE) Certification:

- 24 hour Standardized Field Sobriety Testing (SFST) certification
- 16 hour Advanced Roadside Impaired Driving Enforcement (ARIDE) completion
- 72 hour (minimum) Drug Recognition Expert School
- 40-60 hours field certification process
- 6-10 hour Final Exam
- Recommendation from 2 DRE Instructors

DREs conduct a 12-step evaluation on individuals suspected of OUI to determine:

- Is the person impaired, and is impairment consistent with their BAC;
- If the impairment caused by a medical problem or by drugs. If medical, refer subject for care; if drugs, classify category(s) for prosecution.

7 Central Street, Suite 100
Arlington, Massachusetts 02476-4816
Telephone: (781) 646-4377 Fax: (781) 643-3069
www.ledimensions.com

DRE 12-Step Evaluation

1. Breath test.
2. Interview of arresting officer.
3. Preliminary exam of the subject (preliminary eye checks, pulse check).
4. Eye Exams (HGN, Vertical nystagmus, Lack of Convergence).
5. Divided attention exams (Modified Romberg, Walk and Turn, One Leg Stand − twice, done on both legs, Finger to Nose).
6. Vital Signs (Pulse, blood pressure, body temperature).
7. Dark Room Exams (Pupil sizes in 3 lighting conditions, reaction of pupils to light, check of mouth and nose).
8. Muscle tone check.
9. Injection sites check (and third pulse check).
10. Subject statements.
11. DRE Opinion.
12. Toxicological Exam (Urine or blood).

Support legislation to suspend drivers' licenses for failure to participate in blood, breath, or DRE tests. House Bill No. 3038, An Act Relative to Drug Driving, was proposed by Norfolk District Attorney Michael Morrissey. It seeks to replace G.L. c. 90, § 24 (f)(1), the portion of the OUI statute that concerns the suspension of a person's license for refusing to submit to a breath or blood test following a suspected OUI.

The new version of the law adds that a person who is arrested for OUI liquor or drugs shall be deemed to consent to a chemical test, analysis of his breath or blood, or "a test performed by a *certified Drug Recognition Expert*" if arrest for OUI drugs. The chemical or blood tests shall be administered at the direction of a police officer or certified DRE. A DRE would be defined in 90C § 1, as "any police officer defined in this section who has completed the training requirement for a certification or accreditation by any state or maternal organization."

The proposed law also adds a prior conviction of operating under the influence of drugs to the list of offenses that result in a license suspension of three years for refusal to submit to a blood test, breath test, or test by a DRE.

NBER WORKING PAPER SERIES

EARLY EVIDENCE ON RECREATIONAL MARIJUANA LEGALIZATION AND TRAFFIC FATALITIES

Benjamin Hansen
Keaton S. Miller
Caroline Weber

Working Paper 24417
http://www.nber.org/papers/w24417

NATIONAL BUREAU OF ECONOMIC RESEARCH
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Early Evidence on Recreational Marijuana Legalization and Traffic Fatalities
Benjamin Hansen, Keaton S. Miller, and Caroline Weber
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ABSTRACT

Over the last few years, marijuana has become legally available for recreational use to roughly a quarter of Americans. Policy makers have long expressed concerns about the substantial external costs of alcohol, and similar costs could come with the liberalization of marijuana policy. Indeed, the fraction of fatal accidents in which at least one driver tested positive for THC has increased nationwide by an average of 10 percent from 2013 to 2016. For Colorado and Washington, both of which legalized marijuana in 2014, these increases were 92 percent and 28 percent, respectively. However, identifying a causal effect is difficult due to the presence of significant confounding factors. We test for a causal effect of marijuana legalization on traffic fatalities in Colorado and Washington with a synthetic control approach using records on fatal traffic accidents from 2000-2016. We find the synthetic control groups saw similar changes in marijuana-related, alcohol-related and overall traffic fatality rates despite not legalizing recreational marijuana.

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1 Introduction

The landscape of marijuana regulation is changing rapidly. Marijuana is or will soon be legal for recreational use for a quarter of the United States population, and several countries worldwide have legalized marijuana in some form. Though legalization has reached record levels of popular support, significant opposition remains. The potential for an increase in traffic fatalities caused by impaired drivers remains at the forefront of the debate among policy makers and in the media (Aaronson, 2017; Guion and Higgs, 2018; Leblanc, 2018; Elliot, 2018). Indeed, initial reports have identified significant increases in collision frequencies in Colorado, Washington, and Oregon after marijuana markets opened in those states (Highway Loss Data Institute, 2017), as well as increases in the nominal number of drivers involved in fatal crashes who test positive for marijuana—also referred to as marijuana-related fatalities (Migoya, 2017).[1]

Researchers across disciplines have responded to this public interest. Several authors have examined trends in traffic fatalities in individual states following various liberalizations in marijuana policy and have generally found increases in the rates of THC-positive drivers (Salomonsen-Sautel et al., 2014; Pollini et al., 2015; Aydelotte et al., 2017). However, throughout this literature, researchers have faced a consistent set of methodological challenges. Contemporaneous trends in the state-level price of, and demand for, intoxicating substances make it difficult to find a clean event study. Achieving identification with a differences-in-differences approach is hampered by state-level variation in reporting prac-

[1] Note that, unlike alcohol, the link between particular levels of THC in the bloodstream and increases in the risk of fatal traffic accidents has not yet been precisely determined (Bondallaz et al., 2017). We follow the existing literature and media coverage by using the term "marijuana-related fatalities" while noting that "marijuana-related" does not mean "marijuana-caused."

tices, regional-level variation in preferences for substance consumption, and spillover effects of legalization efforts (Hansen et al., 2017a) – all of which make choosing an appropriate control group *a priori* difficult (Romano et al., 2017).

We resolve these challenges by using a synthetic control approach. We create a control group by choosing weights for states which have not legalized marijuana to match moments of key variables in the pre-legalization period including testing rates for drugs and alcohol, trends in vehicle miles traveled (VMT), urbanicity, macroeconomic conditions, and pre-treatment trends of our outcome variables. We analyze our treated states relative to their synthetic controls in the post period to estimate the causal impact of legalizing marijuana for recreational use on traffic fatalities.

We find that states that legalized marijuana have not experienced significantly different rates of marijuana- or alcohol-related traffic fatalities relative to their synthetic controls. To ensure our results are not driven by an idiosyncratic selection of control weights, we show that we obtain similar results across reasonable variations in the pre-period specification used to created the weights that generate the synthetic control counter-factual. In addition to examining fatalities identified by states as drug- or alcohol-related, we also look for changes in the overall fatality rate to avoid state-level differences in classification (as opposed to state-level differences in testing) and find a similar null result.

We proceed in Section 2 with a brief summary of the history of marijuana policy in the United States and the existing research on the risks of impaired driving. In Section 3, we discuss the Fatal Analysis and Reporting System data and our synthetic control approach. We present our results in Section 4. We conclude in Section 5 with a discussion of the policy implications of our findings.

2 Background

2.1 The legal status of marijuana

Marijuana was legal in the United States until the passage of the Marijuana Taxation Act of 1938 – though many states had banned the substance earlier (Sanna, 2014, p. 88). The Controlled Substances Act of 1970 significantly strengthened the prohibition of marijuana: the substance was classified as a Schedule I drug with a 'high potential for abuse and little known medical benefit.'[2]

Public attitudes about marijuana consumption have become more favorable over the past century, particularly shifting towards support for medical uses of the substance. In 1973, Oregon became the first state to decriminalize marijuana possession, though cultivation and distribution of the drug remained felony offenses. A number of ballot initiatives and legislative efforts across states culminated with California voting to legalize marijuana for medical use (so-called "medical marijuana") in 1996. The other west coast states, Oregon and Washington, followed suit in 1998. Today, 27 states and regions permit broad forms of medical marijuana, despite the continued nominal prohibition at the federal level. Indeed, in 2009, the Department of Justice responded to changes in state laws and public opinion by declaring that "federal resources in States [with medical marijuana laws]" should not be focused "on individuals whose actions are in clear and unambiguous compliance with [those laws]" (Ogden, 2009, p.2).

The liberalization of marijuana policy reached another milestone in 2012, when voters in Washington and Colorado approved ballot initiatives which explicitly legalized the produc-

[2]Other Schedule I substances include heroin and methamphetamine.

tion and consumption of marijuana for recreational use (recreational marijuana). Alaska and Oregon followed suit with similar ballot measures in 2014, and California, Nevada, Maine, and Massachusetts legalized marijuana with ballot measures in 2016. In 2018, Vermont became the first state to legalize the recreational use of marijuana via legislative action. Figure 1 illustrates the current legal status of marijuana by state.

In 2013, during the implementation of Colorado and Washington's legalization initiatives, the Department of Justice responded to the Washington and Colorado efforts by providing enforcement guidance to U.S. Attorneys in the form of specific priorities (Cole, 2013). One major priority was "preventing drugged driving and the exacerbation of other adverse public health consequences associated with marijuana use."[3] States have responded by bolstering efforts to monitor and prevent marijuana-impaired driving (Rocky Mountain High Intensity Drug Trafficking Area, 2017; Hillstrom, 2018).

2.2 Research on impaired driving

Given that traffic accidents are a leading cause of death in the United States, there has been considerable interest in understanding the relationship between various intoxicants, including marijuana, alcohol, and other drugs, and driving performance, accidents, and fatalities. A number of interdisciplinary efforts have studied the risks of intoxicated driving using a variety of approaches, which we outline in this section.

One approach examines impaired driving in a laboratory setting by putting intoxicated subjects into driving simulators and comparing their performance to the performance of

[3] Another key priority was "preventing the diversion of marijuana from states where it is legal under state law in some form to other states." Hansen et al. (2017a) study this question by examining the change in sales along the Washington-Oregon border when Oregon's market opened, and conclude that roughly 7% of marijuana grown in Washington was trafficked out-of-state before Oregon's retailers opened.

sober subjects under a variety of traffic and road conditions (Smiley et al., 1981; Liguori et al., 1998). Due to the Schedule I status of marijuana in the U.S., this approach has been used most often in Europe (Veldstra et al., 2015). Bondallaz et al. (2017) review this literature and find that marijuana use impairs driving primarily by increasing lane weaving and decreasing the mean distance between vehicles. However, they also find significant discrepancies between studies and note that the "the neurobiological mechanisms underlying the effects... remain poorly understood, as does the correlation between body fluids concentrations and psychoactive effects of THC." Hostiuc et al. (2018) performed a meta-analysis of epidemiological studies of marijuana consumption and driving performance and found a statistically insignificant effect size and substantial publication bias.

Another series of studies uses roadside surveys to estimate the proportion of drivers who are intoxicated with various substances. These efforts are often sponsored by law enforcement agencies or other government bodies due to the expense involved. For example, the National Highway Traffic Safety Administration (NHTSA) in the United States has conducted several national surveys of weekend nighttime drivers, with the most recent survey conducted from 2013-2014 (Burning et al., 2015). The results show that the percentage of drivers with non-zero blood-alcohol levels has decreased, while the percentage of drivers with THC in their blood has increased. NHTSA also conducted a "crash risk" study in which data was collected from 3,000 crash-involved drivers and 6,000 control drivers selected by location, time of day, and direction of travel (Compton et al., 2015). They conclude that the presence of any THC in the bloodstream leads to a 25% increase in the probability of a crash of any severity. Taken together, these results suggest that concerns about increases in fatalities as a consequence of marijuana liberalization are well-founded, but cannot demonstrate a causal effect themselves.

A third line of research uses the well-known differences-in-differences approach to study the impact of particular laws on fatalities by analyzing crash data collected by the federal and state governments. In addition to those efforts mentioned previously, Anderson et al. (2013) studied the impact of medical marijuana laws and found that such laws led to decreases in traffic fatalities. Their results were replicated with additional years of data in 2017 (Santaella-Tenorio et al., 2017). Hansen (2015) provides evidence with a regression discontinuity design (derived from BAC legal limits) that harsher punishments are effective in reducing drunk driving, though Anderson and Rees (2015) studied *per se* drugged driving laws and found that such laws do not lead to decreases in fatalities.

A final approach, introduced by Levitt and Porter (2001), takes advantage of the fact that fatal crashes typically involve multiple vehicles. By examining the relative frequency of accidents involving drivers of different types (i.e. intoxicated and sober), one can separately identify the fraction of drivers who are of different types and the relative risks of causing a fatal accident. Levitt and Porter focused on alcohol intoxication and found that drivers with a blood-alcohol concentration of 0.10 or higher are 13 times more likely to be the cause of fatal accidents. However, this approach has been difficult to adapt to the question of marijuana-related accidents due to the variation in testing standards across states and the poorly understood relationship between THC blood test results and driving behaviors.

3 Data and Methodology

To study the relation between recreational marijuana and traffic fatalities, we obtain data from the Fatal Analysis and Reporting System (FARS), which is a system maintained by the federal government that records every fatal car accident in the United States. For each accident reported, the system records information on the circumstances, total injuries and fatalities, and demographics of the drivers. Each entry in the system also includes additional reports on the results from tests for illegal drugs and alcohol, if such tests occurred.

We obtain FARS data from 2000-2016 and construct a state level panel of several key variables to measure the impacts of recreational marijuana legalization on traffic fatalities. We focus on six outcomes. The first is the fraction of fatal accidents that involve at least one driver with a positive drug test for marijuana, which we refer to as marijuana-related fatalities. We also examine the fraction of fatal accidents that involve at least one driver with a positive alcohol test, which we refer to as alcohol-related fatalities. As accidents are related to the overall amount of traffic in a region, we construct the total marijuana-related fatalities per billion VMT and the total alcohol-related fatalities per billion VMT to test whether legalizing recreational marijuana creates spillover effects for drunk driving. Lastly, in part because test rates vary from 40-60 percent for drugs and alcohol in most states, we also estimate the impact of recreational marijuana laws on the total number of fatalities per billion VMT and the fraction of deaths that are "sober" (i.e. those in which none of the drivers test positive for marijuana or alcohol).

Four states—Colorado, Washington, Oregon and Alaska—legalized recreational marijuana before 2016, which is the last year currently covered by FARS. As discussed in Section 2, Washington and Colorado voted to legalize in 2012 and recreational marijuana retailers in those states began operation in 2014. Alaska and Oregon voted to legalize in 2014 and retail operations in those states began in 2015. Because FARS only provides a year of post-legalization data for Alaska and Oregon, we focus on Colorado and Washington as our treated states.[4]

Figures 2, 3, and 4 plot the trend of each of our outcomes separately for Washington, Colorado, and all other states (excluding Oregon and Alaska). The data that drive the results of previous research efforts immediately jump out: marijuana-related deaths go up significantly in both Washington and Colorado after marijuana is legalized in 2012 and these deaths are going up much faster than in the rest of the United States. However, finding appropriate control groups for states such as Washington and Colorado is difficult. Figures 2, 3, and 4 highlight that using the rest of the United States as a comparison group is highly suspect as the outcomes for Washington and Colorado do not move closely with the rest of the United States, nor do they even move closely with each other (i.e. parallel trends do not hold). Moreover, if we were to narrow the comparison group down, many of Colorado's neighbors have different levels and trends of drunk and high driving. And, while Oregon might seem like a natural counterfactual for Washington, Oregon legalized shortly after Washington. Furthermore, recent evidence from Hansen et al. (2017a) suggests inter-state spill-overs would prevent nearby states from serving as reasonable control groups.

To address this concern, we turn to a synthetic control approach inspired by Abadie et al. (2010). The approach uses state-level data to create a counter-factual group that can

[4]Furthermore, Oregon passed legislation in 2015 which substantially increased speed limits on many of its freeways. Higher speeds are associated with increased traffic fatalities, which would bias any estimates examining the effect of recreational marijuana legalization in Oregon upwards (Ashenfelter and Greenstone, 2004; van Benthem, 2015; DeAngelo and Hansen, 2014).

resemble both the averages and trajectories of treated units experiencing a change a discrete change in policy. This approach has been used to study a wide variety of policy changes including the decriminalization of prostitution (Cunningham and Shah, ming), highway police budget cuts (DeAngelo and Hansen, 2014), minimum wage increases (Jardim et al., 2017), and economic liberalization (Billmeier and Nannicini, 2013).

Consider a setting with Y_{it} where i represents a unit, such as a state, and t represents a time period, such as a year. The estimator estimates the impact of a treatment for unit i in time period t by estimating $Y_{it} - \sum_{j \neq i}^{S} Y_{jt} W_j$, where W_j is a weight for unit j. While any potential weighted average of control units is a synthetic control, the standard approach is to choose weights based on minimizing the distance of selected variables between the treated unit and the potential synthetic control units. For each of our exercise, we create a synthetic control with the lagged values of the dependent variable from 2000-2013 (in two year bins), local economic conditions as measured by the unemployment rate, alcohol and marijuana testing rates, VMT[5], and the fraction of VMT driven on urban as opposed to rural roads.

To conduct hypothesis tests, we use the placebo based inference approach suggested by Abadie et al. (2010). We estimate the same synthetic control design model for every placebo state. We then compare the ratio of the mean squared error ($\frac{PostMSPE}{PreMSPE}$) of the actual values less the synthetic control predictions for the actual treated units (Colorado and Washington) to the distribution of the placebo units. The ranking of the treated units relative to the placebo units for those ratios provides an empirical p-value as a permutation based test.

[5]Given that the onset of the great recession was accompanied by a simultaneous drop in VMT, we match on VMT flexibly. We include an average over the years 2000-2007 (pre-recession), 2008-2010 (the recession), and 2011-2013(post recession).

4 Results

4.1 Marijuana-related fatalities

Figure 5 illustrates the prevalence of marijuana-related fatalities in Colorado and its synthetic counterpart from 2000-2016. Panel (a) of the figure illustrates the fraction of accidents that are marijuana-related while Panel (b) illustrates the number of marijuana-related traffic fatalities per billion VMT. Over the 14 year window from 2000-2013 (prior to Colorado's legalization), the trends and levels of synthetic group closely mirrors Colorado's. In the period following legalization, the synthetic region still tracks Colorado's. This suggests that the upward trend in marijuana-related fatalities in Colorado would have taken place whether or not recreational marijuana was legalized. The point estimates corresponding with the Figure are in Table 6, with permutation based p-values in the brackets. The permutation tests suggest that the small deviations we observe in the data are likely due to noise, and there is little evidence supporting a causal interpretation. Panels (c) and (d) of Figure 5 visually illustrate the statistical precision of the synthetic control estimates. The solid black lines represent the difference between Colorado and its synthetic counterpart. The black line hovers around zero both before and after legalization. Moreover, the slight increase apparent for high fatalities per billion VMT is well within the deviations we see in the post period for placebo states.

We repeat the analysis for Washington in Figure 6. Panel (a) illustrates a consistent upward trend in the fraction of fatal accidents involving marijuana, although Washington displays more volatility than Colorado. The synthetic control for Washington shows a similar trend prior to legalization and, although it dips relative to Washington in 2014, similar levels in 2015 and 2016. In Panel (b), the synthetic counterpart struggles to match the overall levels and trends of Washington during the pre-treatment period. While the trend of the synthetic control is similar to Washington's overall trend upward and then back down before legalization, Washington's data are volatile and the overall fit is relatively poor compared to Colorado's. For this reason, despite a somewhat sizable percentage increase in high traffic fatalities per VMT, the placebo-based p-value seen in Table 6 is still 0.404, and indeed as shown in Panel (d), many placebo units had more volatility in the post period than Washington. Furthermore, most of Washington's estimated average increase in the fraction of fatalities that are marijuana-related is driven by a large increase in 2014. Notably, in this year marijuana sales were only 3,991 pounds in Washington, while they increased to 66,390 pounds in 2015 and 179,301 pounds in 2016. So while recreational sales were increasing over those years, the synthetic unit caught up with and more closely tracked Washington's marijuana-related traffic fatalities during the same period.

Our synthetic control estimates suggest that marijuana-related fatalities increased in states without recreational legalization. So while marijuana-related fatalities per billion VMT went up by more than 60 percent in the years after legalization, our point estimates suggest that only 45 to 60 percent of this increase is caused by the legalization of marijuana—though the effect is not statistically distinguishable from zero. While these synthetic control analyses do not provide compelling evidence that marijuana-related fatalities rose, it could be that other types of fatal accidents shifted.

4.2 Alcohol-related fatalities

Researchers have long debated the potential substitutability or complementarity between alcohol and marijuana (Miller and Seo, 2018). Indeed a naive examination of drunk related deaths in Colorado and Washington would lead to the conclusion that fraction of deaths that involve alcohol fell by roughly 10 percentage points in Colorado and Washington after legalization. With that in mind, we turn to examining alcohol-related fatalities in Washington and Colorado.

Figure 7 plots alcohol-related traffic fatality data for Colorado and its synthetic counterpart from 2000-2016. Panel (a) of the figure illustrates the fraction of all fatalities that are alcohol-related while Panel (b) depicts alcohol related traffic fatalities per billion VMT. The trends and levels of synthetic group closely follows Colorado's for the years leading into marijuana legalization. While the fraction of accidents that are alcohol related drops after Colorado's legalization, a similar drop is predicted for Colorado's synthetic counterpart. Table 2 contains the point estimates and the permutation-based p-values in the brackets. The permutation tests also suggests that the small deviations we estimate are more likely due to noise, and there is little evidence supporting an actual causal deviation. Panels (c) and (d) of Figure 7 illustrate the precision of the synthetic control estimates. Similar to the figures for high driving, the solid black lines represent the difference between Colorado and its synthetic counterpart. The black line hovers around zero both before and after legalization. Moreover, the deviations for either measure of alcohol related fatalities is well within the deviations we see in the post period for placebo states.

The analogous analysis for Washington is shown in Figure 8. The synthetic control approach performs admirably in matching the trends and levels of the fraction of accidents that are alcohol related in Panel (a). In Panel (b), the synthetic control for Washington matches both the levels and the time trends. While there is a gap between Washington and its synthetic control during the post period, the gap develops a few years earlier. If we were to take it at face value, it has almost equal magnitude (with opposite sign) to the increase in high related traffic fatalities based on the point estimates in Tables 6 and 2 (0.389 and -.0479 traffic fatalities per billion VMT). The p-values for both the fraction of fatalities that are alcohol-related and alcohol-related fatalities per VMT indicate that we cannot reject the null hypothesis that legalization caused no changes. As with the Colorado exercise, the plots in Panels (c) and (d) suggest that model fit for the treated states did not deviate sharply after treatment began.

4.3 Overall Fatalities

Our analyses of marijuana- and alcohol-related fatalities provide little evidence to support the hypothesis that recreational marijuana laws increase traffic fatalities. However, several confounding factors remain. Despite our efforts to adjust for differences in testing rates, it could be the case that fatality measures could shift in response to changes in testing regimes purely as a reporting effect. If this were the case, we would expect as testing for marijuana-related fatalities rises, sober fatalities fall. Whatever the testing regime, many individuals in traffic accidents are never tested for drugs or alcohol, so it could be the case that individuals involved in a fatal crash are impaired by substances but our prior measures would fail to capture that impairment.

At the same time, many individuals who test positive for marijuana may not be impaired at the time of driving even if they test positive for THC or cannabinoids as those chemicals persist in the bloodstream for days after use (Odell et al., 2015).[6] For this reason, we might expect to see marijuana-related fatalities increasing due to an increasing prevalence of use—use which may or may not be associated with risky driving behaviors. Indeed, in Figure 9, we compare fatal accident rates at different times of day across marijuana-related, alcohol-related, and substance-free accidents. Alcohol-related fatalities follow a distinct temporal pattern with most accidents occurring in the evening. Accidents without marijuana or alcohol show a time of day pattern consistent with commuting times, with increase in the morning and in the late afternoon and early evening. Marijuana related fatalities show a time of day pattern that more closely resembles sober driving. While there are more early morning fatal accidents, this hourly distribution is actually what one might expect if marijuana-related fatalities are driven by a latent mixture of drivers who are truly impaired by marijuana (who have a similar time-of-day pattern to drunk drivers), and drivers who test positive for marijuana but who are actually sober at the time of the accident (who have similar a time-of-day pattern to sober drivers).

As a consequence, we now focus on the overall traffic fatality rate and the rate of sober fatalities (those not involving the presence of either alcohol or marijuana). Indeed, despite our high p-values, given that we tested multiple hypotheses in the previous section, one natural solution to multiple hypothesis testing is aggregation. Lastly, analyzing the total number of fatalities informs us about the net impact of legalization including any substitution

[6] Though FARS reports blood-alcohol levels precisely, the concentrations of THC and other cannabinoids are not reported.

or complementary effects that may exist.

Figure 10 contains plots for overall traffic fatalities and sober driving in Colorado and its synthetic counterpart from 2000-2016. Panel (a) of the figure focuses on the fraction of "sober" accidents – those that do not involve alcohol or marijuana – and Panel (b) illustrates total traffic fatalities per million VMT. Over the window from 2000-2013, prior to legalization in Colorado, the trends and levels of the synthetic group closely mirrors Colorado's, particularly for overall traffic fatalities. The same is true for the fraction of fatal accidents that are sober. In the period following legalization, the synthetic region shows a slight up-tick, as does Colorado. This suggests that the overall slight upward trend in traffic fatalities per VMT would have been expected in the absence of legalization. The point estimates corresponding with Figure 10 are in Table 3, with permutation based p-values in the brackets. The permutation tests also suggests that the small deviations we estimate are more likely due to noise, and there is little evidence supporting an actual causal deviation. Panels (c) and (d) of the figure illustrate the relative statistical precision of the synthetic control estimates. The solid black lines represent the difference between Colorado and its synthetic counterpart, while the light grey lines are difference between the placebo states and their synthetic counterparts The black line hovers around zero both before and after legalization. Moreover, the slight increase apparent for high fatalities per billion VMT is well within the deviations we see in the post period for placebo states. Indeed even if we were to take the point estimate at face value, it would suggest traffic fatalities per billion VMT in Colorado have increased by a little over 3 percent. However the placebo derived p-value would suggest the we fail to reject the null hypothesis that this effect is zero.

The analogous plots for Washington are depicted in Figure 11. As shown in Panel (a), the trend of fraction of fatalities that are sober is relative stable leading in to marijuana legalization. While it increases by roughly 10 percentage points in 2014, the synthetic control shows a similar jump. The total fatalities per VMT shown in Panel (b) fall fairly sharply from 2000 to 2010, and then level out for the remain years leading into legalization. Washington's synthetic control unit shows a very similar pattern and trend. After legalization, Washington's fatalities rise, and the synthetic counterpart also shows a notable increase. The point estimate in Table 3 suggest that on average traffic fatalities per billion VMT in WA rose by 8.4 percent. However the p-value of .340 suggests we again fail to reject the null hypothesis that there was no effect of legalization. Likewise the model fits in Panels (c) and (d) suggest that difference between Washington and its synthetic control group was typically nearly the center of distribution provided by the placebo models. Furthermore, the average 8.4 percent increase is largely driven by 2015 alone. This might be more likely due to noise, when we consider the growth of the recreational marijuana market. Indeed, total sales of marijuana more than doubled in 2016, and yet the synthetic control group and Washington converged rather than diverging as the recreational market grew.

In summary, the similar trajectory of traffic fatalities in Washington and Colorado relative to their synthetic control counterparts yield little evidence that the total rate of traffic fatalities has increased significantly as a consequence of recreational marijuana legalization.

4.4 Robustness

Our estimates yield little evidence to support the notion that the legalization of recreational marijuana caused traffic fatalities to double, as has been suggested in the media (Migoya, 2017). However, we made several model choices which could have influenced the results. In this section, we measure the sensitivity of our estimates to these choices by replicating Tables 1, 2, and 3 under a different set of choices we could have reasonably made.

In the earlier analyses we assumed treatment began in 2014, which is when retail stores began selling recreational marijuana in both Colorado and Washington. However, the ballot measures in both states passed in 2012 and immediately legalized possession and consumption of small amounts of the substance, which may have lead individuals to increase their consumption of black market or medical marijuana at that time. In other words, a case could be made that treatment truly began in 2012 rather than later in 2014. As shown in the first panel of Table 4, the estimated impact on the fraction of fatal accidents involving marijuana remains relatively unchanged in both Colorado and Washington, with p-values that remain insignificant. Likewise the marijuana-related fatalities per VMT remain effectively constant in Colorado, and fall to -0.086, or roughly a 10 percent decrease (as opposed to the original 25 percent increase). However this estimate remains insignificant, and should be viewed as additional evidence that the earlier estimates may indeed be more consistent with a null effect. In the first panel of Tables 5 and 6 we report estimates for alcohol-related and overall traffic fatalities, respectively. Broadly, we find similar estimates with large p-values, suggesting that even if we consider treatment as beginning in 2012, recreational marijuana has had a limited impact on drunk driving and overall traffic fatalities in both states.

Our primary specifications allow all states other than Washington and Colorado to enter the synthetic control.[7] However, legalization in one state may lead to substantial spill-over effects in bordering states due to the opportunity for trafficking Hansen et al. (2017a). In

[7] Oregon and Alaska were also excluded as they legalized marijuana in 2015.

the second panel of Tables 4, 5, and 6 we replicate the analyses of Tables 1, 2, and 3 while excluding any states that share a border with any state that legalized recreational marijuana prior to the end of the post period. This includes California, Idaho, Nebraska, Nevada, New Mexico, Oklahoma, Texas, Utah, and Wyoming. This does have potential to affect our estimates as some of these states received positive weight as seen in Appendix Tables 1-4. However, we find similar point estimates and p-values for marijuana-related fatalities, as shown in Table 4. Likewise, the point estimates with this restricted synthetic control set are similar for both alcohol-related and overall traffic fatalities.

Another potential concern could be how sensitive the synthetic control models are to the inclusion of predetermined factors such as economic conditions, VMT, and the marijuana and alcohol testing rates. Including these may seem reasonable, but at the same time, these variables do not share the same importance as predetermined lagged values of the dependent variable in predicting the outcome variables. In the third panel of Tables 4,5, and 6, the point estimates reported reflect models where only predetermined variables were used to select the synthetic control group. For most outcomes, the p-values grew marginally larger. Moreover in some instances the estimated average impact shrunk while in other cases in grew. The estimates were of similar magnitude in most cases, and in all case the p-values remained statistically insignificant.

Lastly, another concern could be the suitability of states adopting medical marijuana as control groups for Colorado and Washington. On one hand, because Colorado and Washington had medical marijuana to begin with, they might be the most natural comparison group. On the other hand, perhaps states that adopted medical marijuana close to the time Colorado and Washington legalized could see their own surge in marijuana use. With this in mind, in the final panel of Tables 4, 5, and 6, we exclude any states that adopt a medical marijuana policy between 2012 and 2016. Generally the estimates are similar qualitatively, as some get a bit larger while others are smaller. Moreover, the p-values are consistently insignificant, suggesting again that the relative changes Colorado and Washington experience are within the expectations for any state which did not change marijuana policy.

5 Policy Implications and Conclusions

The broad trend towards the legalization of marijuana has led to a high degree of interest in social, economic, and public health consequences, both positive and negative. Faced with a steep increase in the fraction of traffic fatalities in which at least one driver tested positive for marijuana, the media and researchers alike have been eager to sound the alarm about this potentially dangerous side effect of the policy (Chen, 2016; Banta-Green et al., 2016; Migoya, 2017; Krieger, 2017). However, these early reports of steep increases are confounded by a number of factors. We contribute to this discussion by using a synthetic control method to compare the outcomes in Washington and Colorado to other states with similar pre-legalization economic and traffic trends. We find the synthetic control groups saw similar increases despite not legalizing marijuana. Moreover, the p-values suggest that the deviations Colorado and Washington did show from their synthetic counterparts are well with the range of deviations seen due to year to year variation.

Several mechanisms may be driving these results. The amount of marijuana sold in recreational stores has grown dramatically, increasing from 3,991 pounds in Washington in 2014 to 179,301 pounds in 2017, while in Colorado it grew from 36,031 pounds in 2014 to 102,871 pounds in 2016. However, it is difficult to discern how much of this growth in legal recreational weed came at the expense of sales in black market or medical marijuana. Indeed recreational marijuana can be viewed as a close substitute to black market or medical marijuana, with differences in price, quality, and ease of access. The relatively small effects we estimate are consistent with crowding-out, and could explain why we don't observe spill-over effects on alcohol-related traffic accidents as other studies have found (Anderson et al., 2013). Furthermore, Colorado has recently allowed consumption of marijuana in public spaces. This might increase the potential for negative externalities of recreational marijuana relative to medical marijuana. Despite that concern, we find limited overall evidence the fatalities are significantly increasing in Colorado and Washington following the legalization of recreational marijuana.

These results also inform optimal tax policy due to the potential externalities associated with marijuana (Hansen et al., 2017b). We show that it may be reasonable to question if recreational marijuana was responsible for the recent increase in traffic fatalities in Colorado and Washington. However, future research might consider other potential externalities such as effects on hospital admissions, crime, and drug overdoses. Accounting for the universe of externalities would help guide tax rates set to internalize externalities, although most states are likely setting tax rates with revenue in mind rather than optimal Pigovian goals.

While our results suggest that the marijuana legalization in Colorado and Washington did not lead to discernible increases in traffic fatalities, estimating the externalities of marijuana abuse and high driving is still crucial in determining future policy. Indeed, while Colorado and Washington have set the legal limit for high driving at 5 nanograms of THC per milliliter of blood, we don't yet know if the sanctions for high driving will be effective in discouraging high driving given the local population of drivers affected by that threshold (Hansen, 2015). Furthermore, there is still ample debate about what the right legal threshold would be, and if the threshold should even be based on THC. While the use of BAC is common today for measuring impairment in drunk driving, it took nearly decades of research and innovation from the passage of the first drunk driving laws to the creation of the first breathalyzers (Novak, 2013). Science and policy alike are playing catch up in both measuring the relative risks of high driving, and high driving itself.

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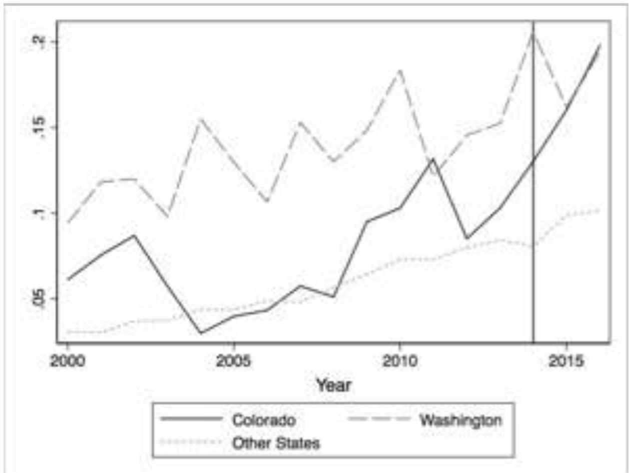
6 Figures and Tables

Figure 1: Marijuana laws by state

Source: Skye Gould/Business Insider

Figure 2: Marijuana-related traffic fatalities in Colorado, Washington and other states

(a) Fraction of Fatalities Marijuana-Related



(b) Marijuana-Related Fatalities per billion VMT

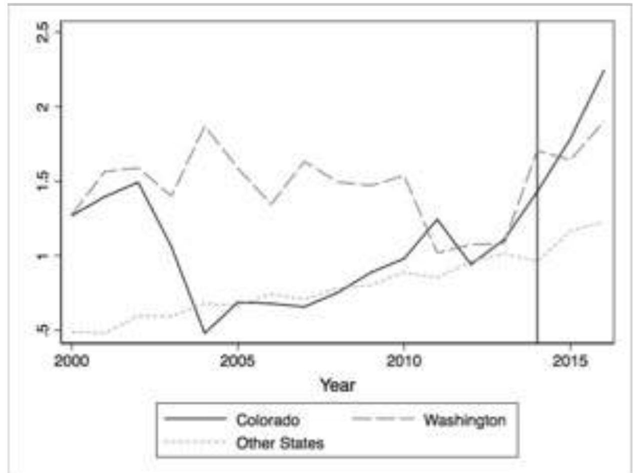
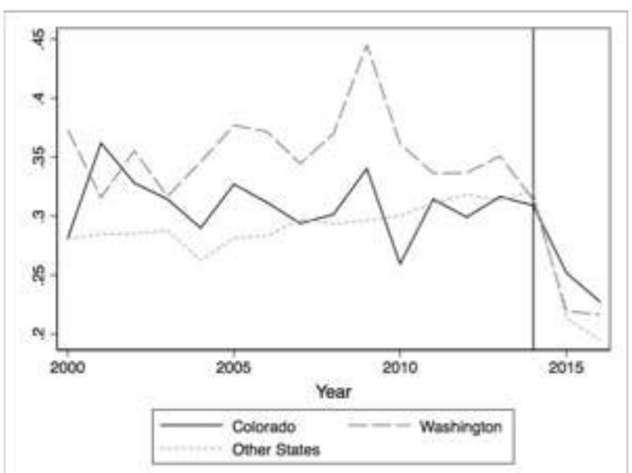


Figure 3: Alcohol-related traffic fatalities in Colorado, Washington and other states

(a) Fraction of Fatalities Alcohol Related



(b) Alcohol-Related Fatalities per billion VMT

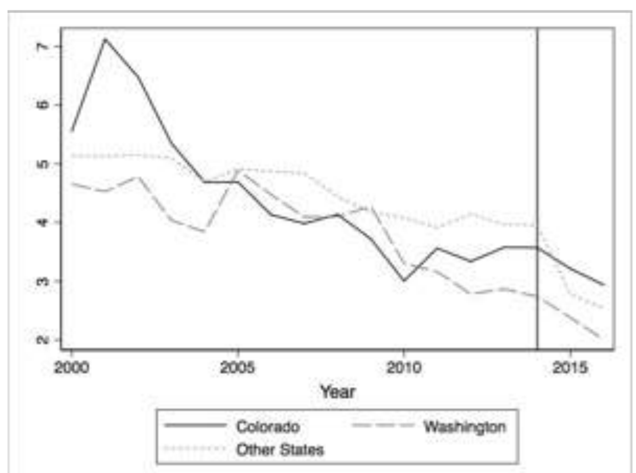


Figure 4: Fatal accident trends in Colorado, Washington and other states

(a) Sober Fatalities per billion VMT

(b) Total Fatalities per billion VMT

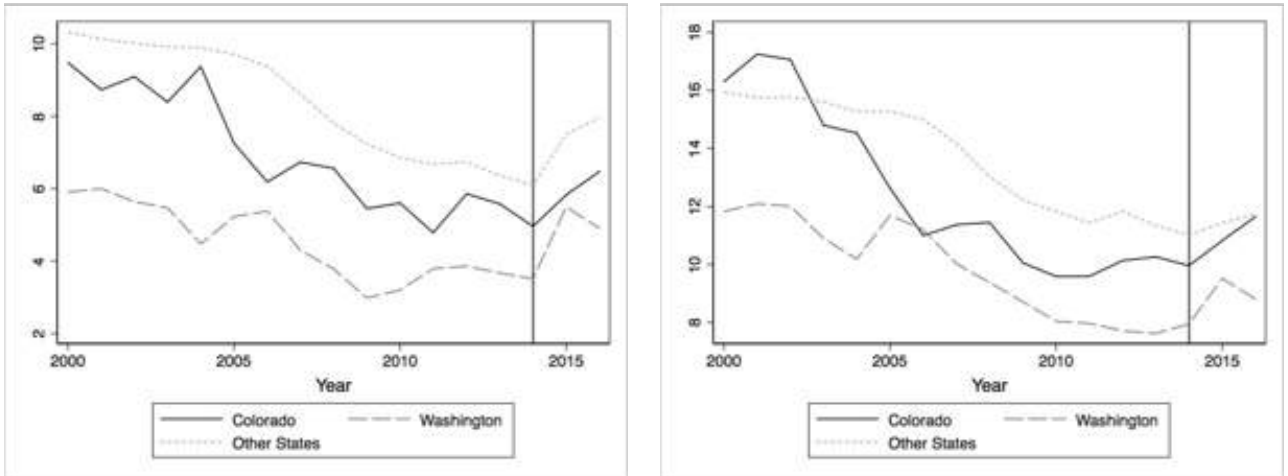
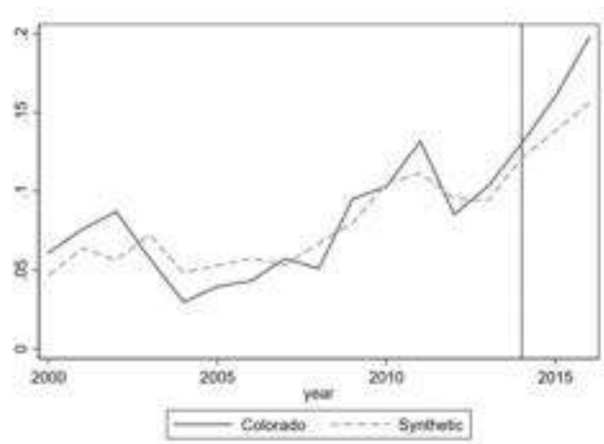
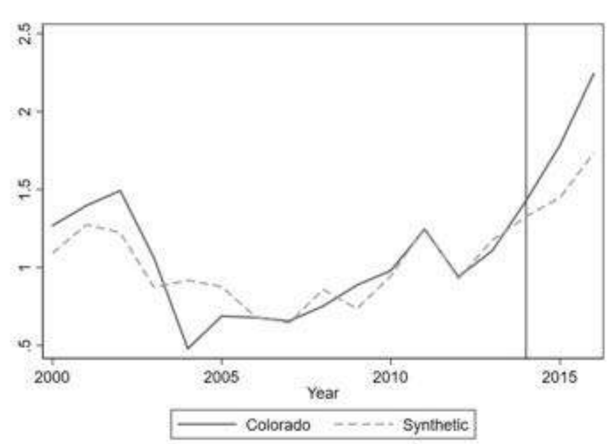


Figure 5: Marijuana-related traffic fatalities in Colorado

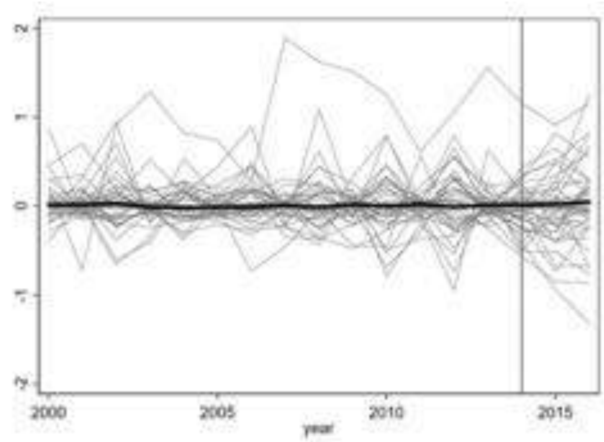
(a) Fraction of Fatalities Marijuana-Related



(b) Marijuana-Related Fatalities per billion VMT



(c) Actual Data-Synthetic Model for Colorado vs. Placebo States



(d) Actual Data-Synthetic Model for Colorado vs. Placebo States

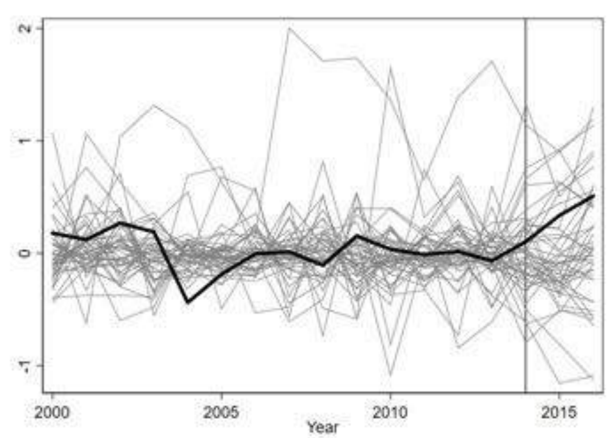
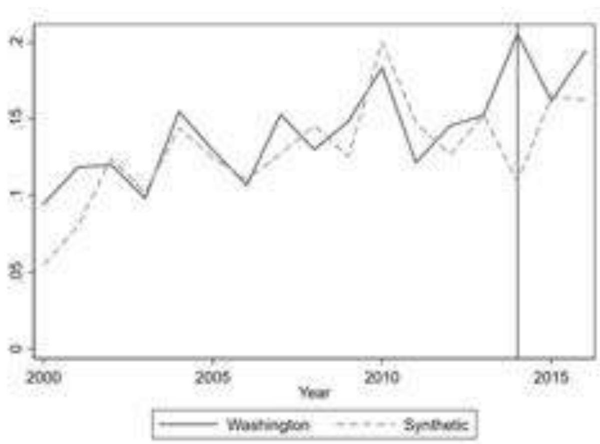
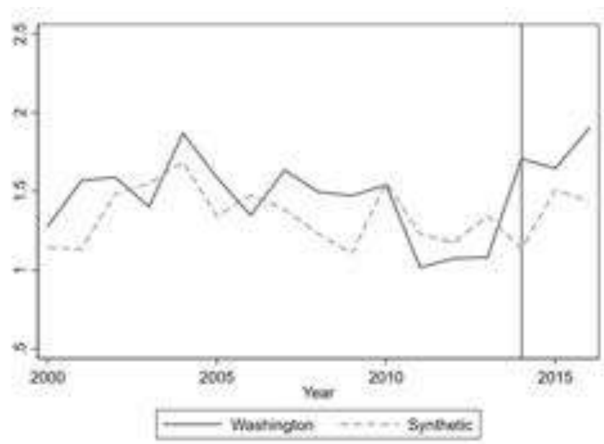


Figure 6: Marijuana-related traffic fatalities in Washington

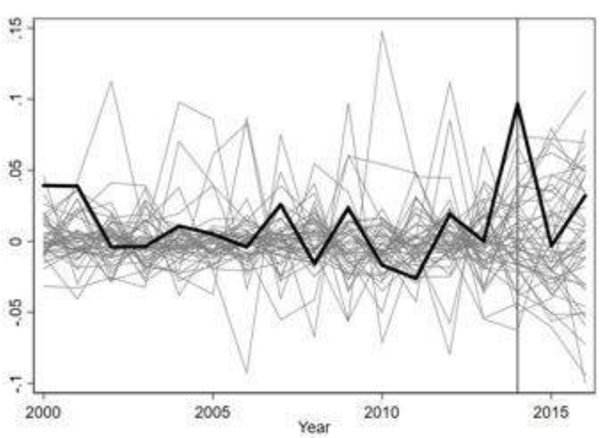
(a) Fraction of Fatalities Marijuana Related



(b) Marijuana Related Fatalities per billion VMT



(c) Actual Data-Synthetic Model for Washington vs. Placebo States



(d) Actual Data-Synthetic Model for Washington vs. Placebo States

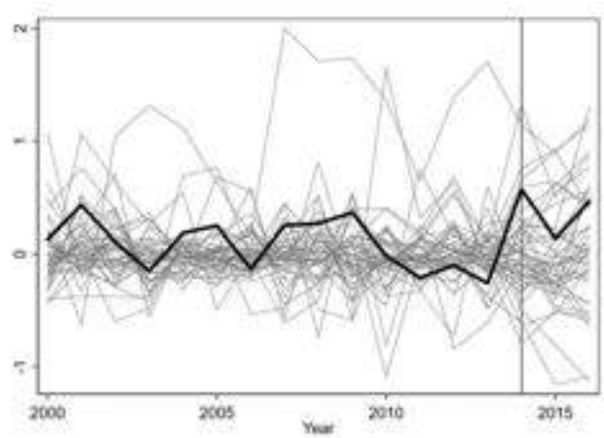
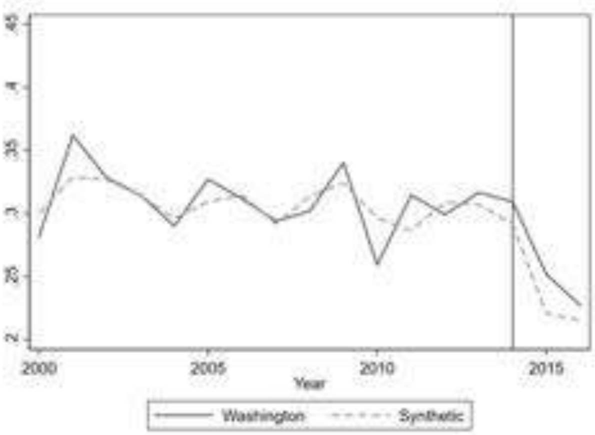
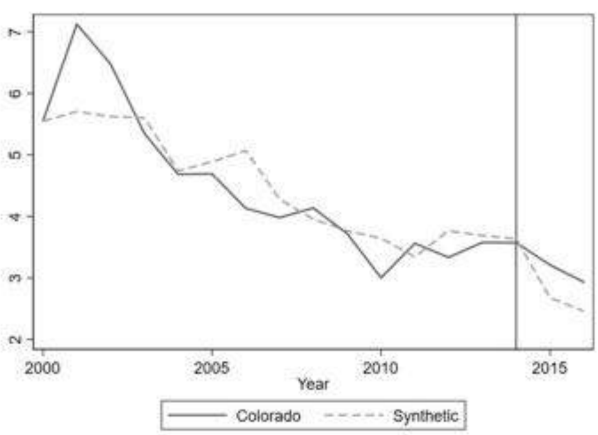


Figure 7: Alcohol-related traffic fatalities in Colorado

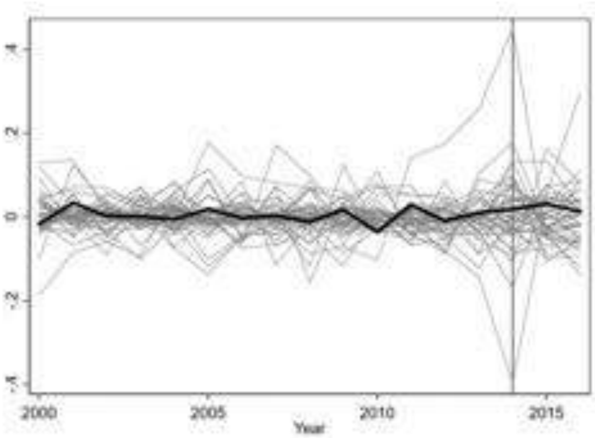
(a) Fraction of Fatalities Alcohol Related



(b) Alcohol-Related Fatalities per billion VMT



(c) Actual Data-Synthetic Model for Colorado vs. Placebo States



(d) Actual Data-Synthetic Model for Colorado vs. Placebo States

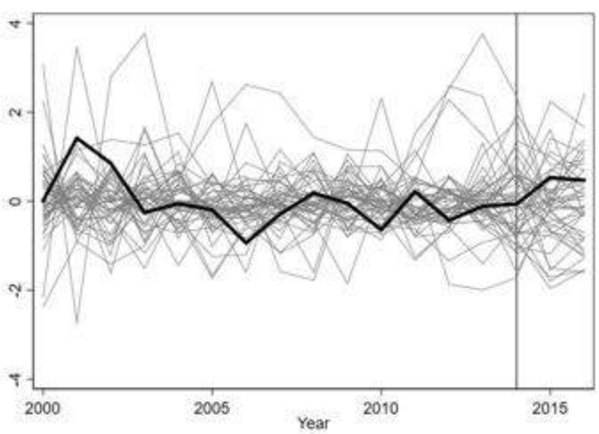
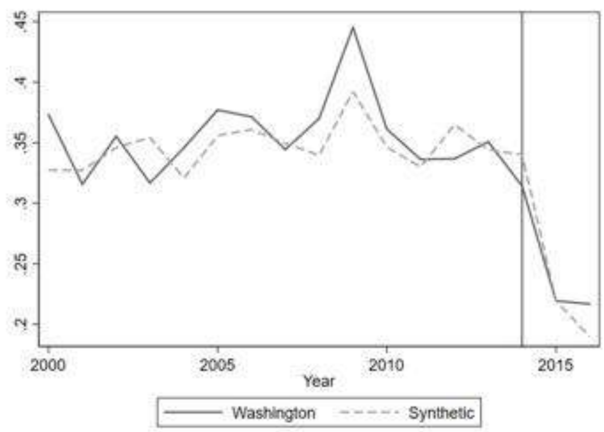
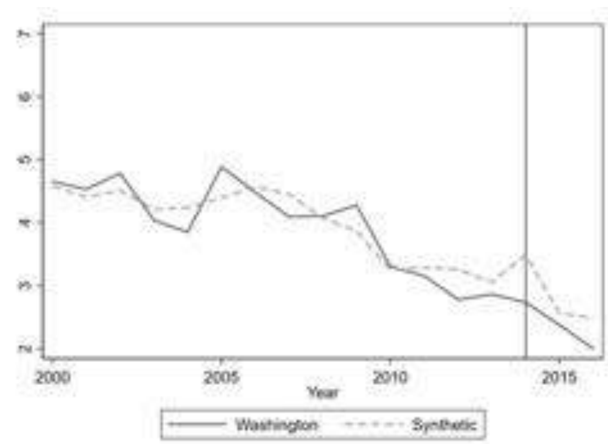


Figure 8: Alcohol-related traffic fatalities in Washington

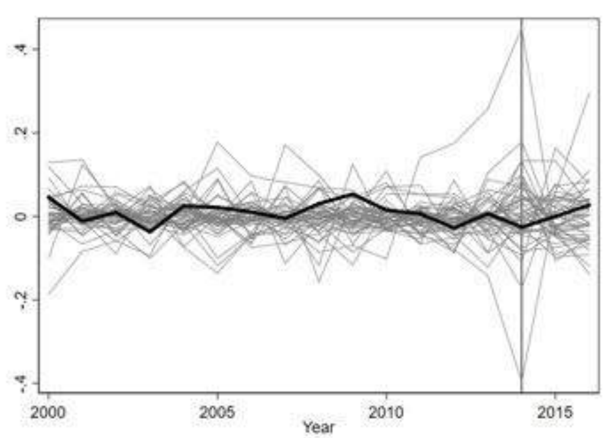
(a) Fraction of Fatalities Alcohol Related



(b) Alcohol-Related Fatalities per billion VMT



(c) Actual Data-Synthetic Model for Washington vs. Placebo States



(d) Actual Data-Synthetic Model for Washington vs. Placebo States

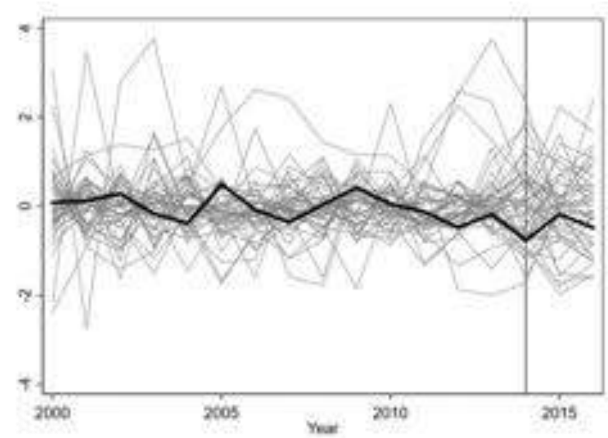
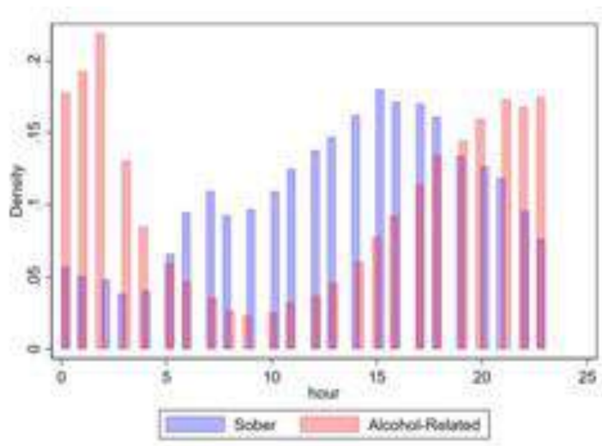


Figure 9: Time of Day for Sober, Alcohol, and Marijuana Related Fatalities

(a) Alcohol-Related Vs. Sober Fatalities



(b) Marijuana-Related vs. Sober Fatalities

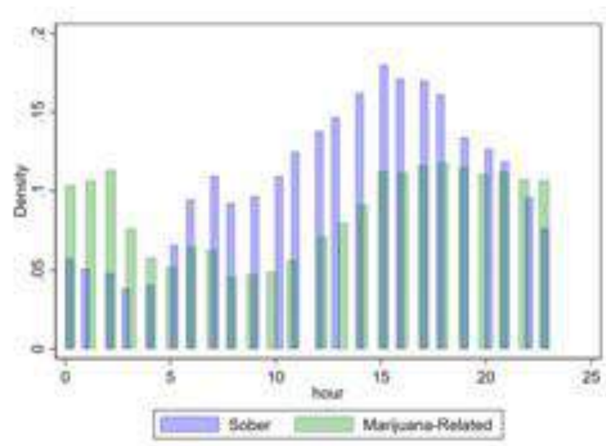
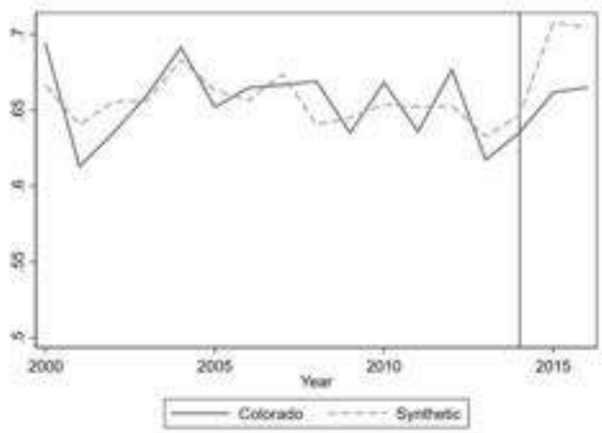
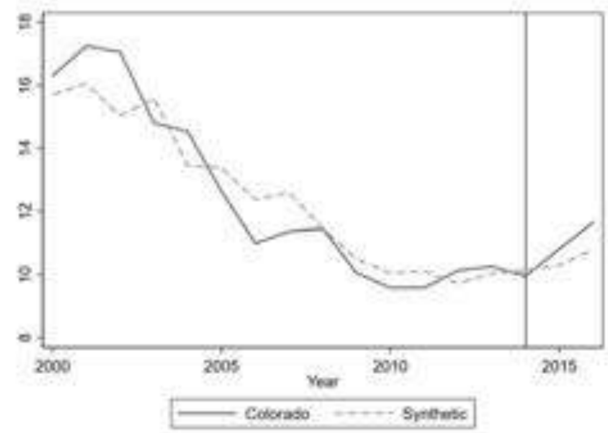


Figure 10: Overall fatalities in Colorado

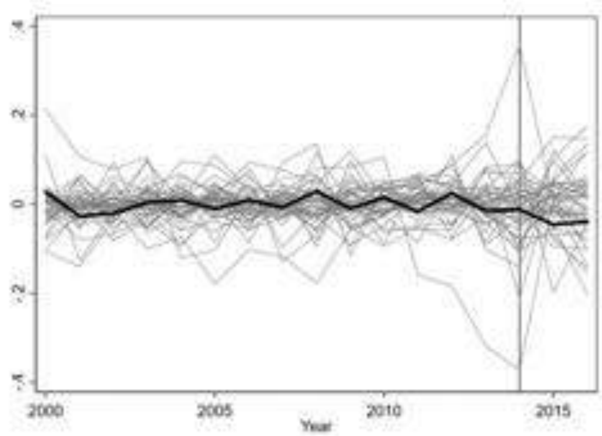
(a) Fraction of Fatalities Sober



(b) Total Fatalities per billion VMT



(c) Actual Data-Synthetic Model for Colorado vs. Placebo States



(d) Actual Data-Synthetic Model for Colorado vs. Placebo States

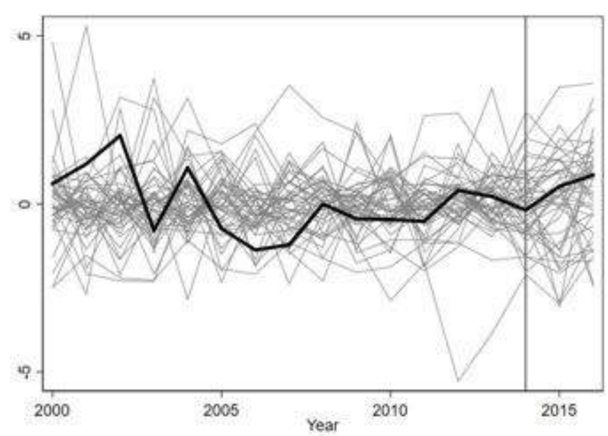
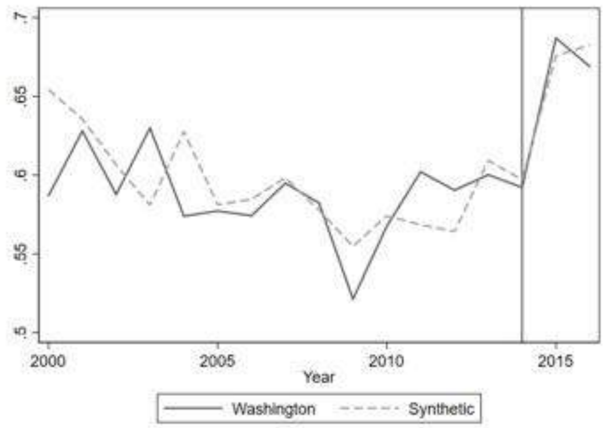
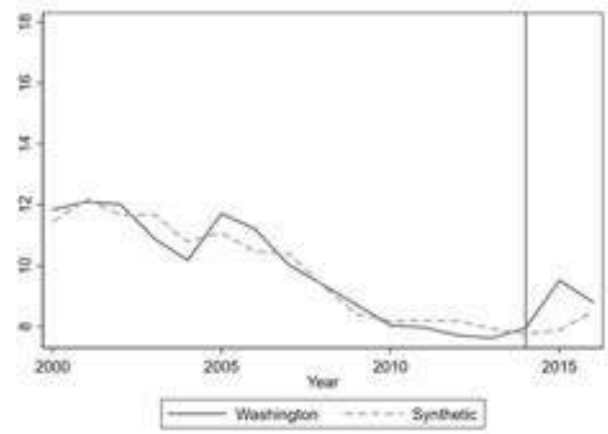


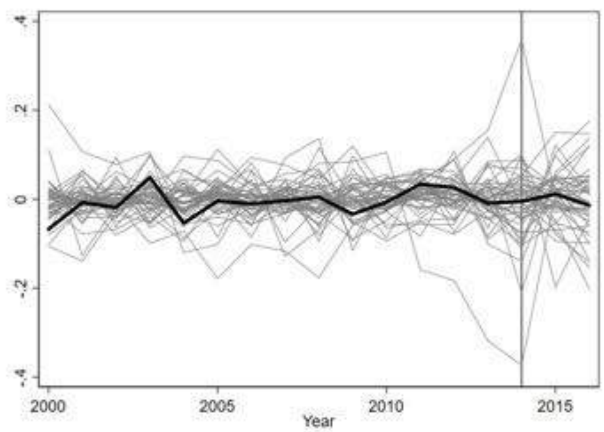
Figure 11: Overall fatalities in Washington



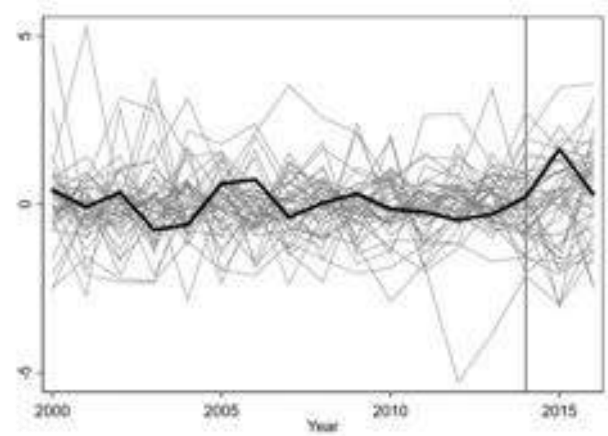
(a) Fraction of Fatalities Sober



(b) Total Fatalities per billion VMT



(c) Actual Data-Synthetic Model for Washington vs. Placebo States



(d) Actual Data-Synthetic Model for Washington vs. Placebo States

Table 1: Recreational Marijuana Law's Impact on Marijuana-Related Traffic Fatalities

	Colorado		Washington	
	Fraction Marijuana Related	Marijuana-related Fatalities per billion VMT	Fraction Marijuana Related	Marijuana-related Fatalities per billion VMT
RML	0.017	0.316	0.041	0.389
P-Value	[0.553]	[0.361]	[0.212]	[0.404]

This table includes synthetic control estimates p-values based on permutation testing of the ratio of mean squared error ratios for the post and pre-intervention periods. For matching predetermined predictors, each model includes the marijuana testing rate, the alcohol testing rate, the fraction of VMT that are urban, the unemployment rate, average VMT for 2000-2007, 2008-2009, 2010-2011, and 2012 and 2013, lagged values of the outcome for two years bins from 2000 through 2014.

Table 2: Recreational Marijuana Law's Impact on Alcohol-Related Traffic Fatalities

	Colorado		Washington	
	Fraction Alcohol Related	Alcohol-related Fatalities per billion VMT	Fraction Alcohol Related	Alcohol Fatalities per billion VMT
RML	0.020	0.313	0.0002	−0.479
P-Value	[0.702]	[0.765]	[0.872]	[0.277]

This table includes synthetic control estimates p-values based on permutation testing of the ratio of mean squared error ratios for the post and pre-intervention periods. For matching predetermined predictors, each model includes the marijuana testing rate, the alcohol testing rate, the fraction of VMT that are urban, the unemployment rate, average VMT for 2000-2007, 2008-2009, 2010-2011, and 2012 and 2013, lagged values of the outcome for two years bins from 2000 through 2014.

Table 3: Recreational Marijuana Law's Impact Overall Fatalities

	Colorado		Washington	
	Fraction Sober	Total Fatalities per billion VMT	Fraction Sober	Total Fatalities per billion VMT
RML	−0.032	0.396	−0.002	0.714
P-Value	[0.319]	[0.872]	[0.957]	[0.213]

This table includes synthetic control estimates p-values based on permutation testing of the ratio of mean squared error ratios for the post and pre-intervention periods. For matching predetermined predictors, each model includes the marijuana testing rate, the alcohol testing rate, the fraction of VMT that are urban, the unemployment rate, average VMT for 2000-2007, 2008-2009, 2010-2011, and 2012 and 2013, lagged values of the outcome for two years bins from 2000 through 2014.

Table 4: Robustness of Estimates of Recreational Marijuana Law's Impact on Marijuana-Related Traffic Fatalities

	Colorado		Washington	
	Fraction Marijuana Related	Marijuana-related Fatalities per billion VMT	Fraction Marijuana Related	Marijuana-related Fatalities per billion VMT
Treatment Begins in 2012				
RML	0.013	0.157	0.042	−0.086
P-Value	[0.489]	[0.319]	[0.170]	[0.893]
Border States Excluded				
RML	0.021	0.244	0.037	0.618
P-Value	[0.489]	[0.297]	[0.234]	[0.255]
Including only Lagged Outcomes as Matching Predictors				
RML	0.016	0.232	0.035	0.432
P-Value	[0.489]	[0.511]	[0.340]	[0.511]
Excluding States that Legalized Medical Marijuana from 2012-2016				
RML	0.043	0.451	0.038	0.445
P-Value	[0.255]	[0.234]	[0.276]	[0.297]

This table includes synthetic control estimates p-values based on permutation testing of the ratio of mean squared error ratios for the post and pre-intervention periods. For matching predetermined predictors, each model includes the marijuana testing rate, the alcohol testing rate, the fraction of VMT that are urban, the unemployment rate, average VMT for 2000-2007, 2008-2009, 2010-2011, and 2012 and 2013, lagged values of the outcome for two years bins from 2000 through 2014.

Table 5: Robustness of Estimates of Recreational Marijuana Law's Impact on Alcohol-Related Traffic Fatalities

	Colorado		Washington	
	Fraction Alcohol Related	Alcohol-related Fatalities per billion VMT	Fraction Alcohol Related	Alcohol-related Fatalities Per billion VMT
Treatment Begins in 2012				
RML	0.002	−0.384	−0.008	−0.577
P-Value	[0.914]	[0.744]	[0.723]	[0.382]
Border States Excluded				
RML	0.017	0.178	0.005	−0.140
P-Value	[0.680]	[0.893]	[0.702]	[0.680]
Including only Lagged Outcomes as Matching Predictors				
RML	0.019	0.128	−0.023	−0.626
P-Value	[0.851]	[0.872]	[0.617]	[0.234]
Excluding States that Legalized Medical Marijuana from 2012-2016				
RML	0.007	0.211	−0.028	−0.556
P-Value	[0.872]	[0.892]	[0.532]	[0.297]

This table includes synthetic control estimates p-values based on permutation testing of the ratio of mean squared error ratios for the post and pre-intervention periods. For matching predetermined predictors, each model includes the marijuana testing rate, the alcohol testing rate, the fraction of VMT that are urban, the unemployment rate, average VMT for 2000-2007, 2008-2009, 2010-2011, and 2012 and 2013, lagged values of the outcome for two years bins from 2000 through 2014.

Table 6: Robustness of Estimates of Recreational Marijuana Law's Impact on Overall Fatalities

	Colorado		Washington	
	Fraction Sober Related	Total Fatalities per billion VMT	Fraction Sober Related	Total Fatalities Per billion VMT
Treatment Begins in 2012				
RML	−0.006	0.918	−0.003	−0.016
P-Value	[0.702]	[0.723]	[0.978]	[0.340]
Border States Excluded				
RML	−0.024	0.526	−0.012	0.880
P-Value	[0.489]	[0.893]	[0.914]	[0.170]
Including only Lagged Outcomes as Matching Predictors				
RML	−0.017	0.283	0.011	0.975
P-Value	[0.829]	[0.957]	[0.872]	[0.191]
Excluding States that Legalized Medical Marijuana from 2012-2016				
RML	−0.043	0.250	0.019	0.721
P-Value	[0.277]	[0.872]	[0.851]	[0.234]

This table includes synthetic control estimates p-values based on permutation testing of the ratio of mean squared error ratios for the post and pre-intervention periods. For matching predetermined predictors, each model includes the marijuana testing rate, the alcohol testing rate, the fraction of VMT that are urban, the unemployment rate, average VMT for 2000-2007, 2008-2009, 2010-2011, and 2012 and 2013, lagged values of the outcome for two years bins from 2000 through 2014.

Appendices

A Appendix Tables

Table A.1: Synthetic Control Covariates

Panel A: Colorado

	Potential Comp. States	Colorado	Fraction Mar. Related	Mar.-related Fatalities per billion VMT	Fraction Alc. Related	Alc.-related Fatalities per billion VMT	Fraction Sober	Total Fatalities per billion VMT
Fraction Urban	0.592	0.681	0.674	0.619	0.593	0.662	0.620	0.727
Drug Test Rate	0.450	0.438	0.428	0.432	0.438	0.451	0.437	0.466
Alcohol Test Rate	0.629	0.563	0.563	0.612	0.671	0.638	0.648	0.575
VMT per Pop (2000-2007)	0.013	0.013	0.013	0.013	0.013	0.013	0.012	0.012
VMT per Pop (2008-2009)	0.013	0.012	0.012	0.012	0.012	0.012	0.012	0.012
VMT per Pop (2010-2011)	0.013	0.012	0.012	0.012	0.012	0.012	0.012	0.011
VMT per Pop (2012-2013)	0.013	0.011	0.012	0.012	0.011	0.012	0.011	0.011
Unemployment Rate	0.063	0.061	0.061	0.062	0.061	0.061	0.059	0.075

Panel B: Washington

	Potential Comp. States	Washington	Fraction Mar. Related	Mar.-related Fatalities per billion VMT	Fraction Alc. Related	Alc.-related Fatalities per billion VMT	Fraction Sober	Total Fatalities per billion VMT
Fraction Urban	0.592	0.707	0.686	0.763	0.695	0.779	0.656	0.835
Drug Test Rate	0.450	0.452	0.490	0.486	0.439	0.472	0.464	0.452
Alcohol Test Rate	0.629	0.596	0.724	0.645	0.627	0.588	0.680	0.591
VMT per Pop (2000-2007)	0.013	0.011	0.011	0.011	0.011	0.012	0.011	0.011
VMT per Pop (2008-2009)	0.013	0.011	0.010	0.010	0.011	0.011	0.011	0.011
VMT per Pop (2010-2011)	0.013	0.010	0.010	0.010	0.010	0.011	0.010	0.010
VMT per Pop (2012-2013)	0.013	0.010	0.010	0.010	0.010	0.011	0.010	0.010
Unemployment Rate	0.063	0.075	0.054	0.066	0.066	0.074	0.057	0.073

This table provides the average covariate values for all potential comparison states (all states except Washington, Colorado, Oregon, and Alaska), the treated states (Washington and Colorado), and the synthetic control for each outcome in Tables 1, 2, and 3. Lagged outcome values are also included as covariates in the models estimates in Tables 1, 2, and 3, but are not listed here. The column titles abbreviate marijuana as mar. and alcohol as alc.

Table A.2: Synthetic Control Weights Assigned to Each State for Marijuana-Related Fatality Outcomes

	Colorado		Washington	
	Fraction Marijuana Related	Marijuana-related Fatalities per billion VMT	Fraction Marijuana Related	Marijuana-related Fatalities per billion VMT
Arkansas	0.083	0.000	0.000	0.000
Connecticut	0.000	0.180	0.000	0.000
Delaware	0.429	0.165	0.000	0.000
District Of Columbia	0.000	0.000	0.166	0.123
Georgia	0.060	0.058	0.000	0.184
Hawaii	0.103	0.120	0.450	0.365
Indiana	0.000	0.000	0.047	0.000
Montana	0.000	0.000	0.054	0.000
Nevada	0.070	0.020	0.000	0.293
New Hampshire	0.051	0.000	0.193	0.000
Rhode Island	0.114	0.022	0.000	0.000
Vermont	0.000	0.000	0.091	0.035
West Virginia	0.090	0.434	0.000	0.000

This table provides the weights assigned to states for the synthetic controls used in Table 1. All states except Washington, Colorado, Oregon and Alaska were states that could have potentially received positive weight for any given synthetic control. All states that received zero weight across all four columns are excluded from this list for the sake of brevity.

Table A.3: Synthetic Control Weights Assigned to Each State for Drunk-Related Traffic Fatalities Outcomes

	Colorado		Washington	
	Fraction Alcohol Related	Alcohol-related Fatalities per billion VMT	Fraction Alcohol Related	Alcohol Fatalities per billion VMT
Arizona	0.000	0.308	0.000	0.000
California	0.000	0.000	0.000	0.354
Delaware	0.351	0.000	0.067	0.000
District Of Columbia	0.000	0.000	0.000	0.067
Florida	0.000	0.107	0.000	0.000
Georgia	0.106	0.000	0.000	0.000
Hawaii	0.089	0.000	0.189	0.000
Illinois	0.000	0.000	0.632	0.000
Louisiana	0.000	0.000	0.000	0.150
Minnesota	0.000	0.147	0.000	0.000
Nevada	0.000	0.000	0.000	0.144
New Hampshire	0.091	0.134	0.000	0.000
Rhode Island	0.190	0.178	0.000	0.114
South Dakota	0.000	0.127	0.112	0.000
Utah	0.000	0.000	0.000	0.172
West Virginia	0.174	0.000	0.000	0.000

This table provides the weights assigned to states for the synthetic controls used in Table 2. All states except Washington, Colorado, Oregon and Alaska were states that could have potentially received positive weight for any given synthetic control. All states that received zero weight across all four columns are excluded from this list for the sake of brevity.

Table A.4: Synthetic Control Weights Assigned to Each State for Overall Traffic Fatality Outcomes

	Colorado		Washington	
	Fraction Sober	Total Fatalities per billion VMT	Fraction Sober	Total Fatalities per billion VMT
California	0.000	0.000	0.000	0.196
Connecticut	0.000	0.000	0.000	0.043
Delaware	0.113	0.000	0.000	0.000
District Of Columbia	0.000	0.255	0.000	0.108
Georgia	0.072	0.000	0.000	0.000
Hawaii	0.048	0.000	0.426	0.000
Illinois	0.000	0.000	0.341	0.000
Massachusetts	0.000	0.000	0.000	0.210
Michigan	0.000	0.275	0.000	0.000
Minnesota	0.000	0.116	0.000	0.000
Mississippi	0.000	0.092	0.000	0.000
New Hampshire	0.205	0.000	0.040	0.000
New Jersey	0.000	0.000	0.000	0.066
Ohio	0.000	0.000	0.000	0.305
Pennsylvania	0.258	0.000	0.000	0.000
Rhode Island	0.040	0.000	0.000	0.072
South Carolina	0.118	0.000	0.000	0.000
South Dakota	0.065	0.000	0.091	0.000
Texas	0.000	0.261	0.000	0.000
Vermont	0.000	0.000	0.101	0.000

This table provides the weights assigned to states for the synthetic controls used in Table 3. All states except Washington, Colorado, Oregon and Alaska were states that could have potentially received positive weight for any given synthetic control. All states that received zero weight across all four columns are excluded from this list for the sake of brevity.

Primer on Diagnostic Studies

Introduction

Determining whether someone is operating under the influence of an impairing substance requires some type of diagnostic testing, whether it be a laboratory test or an evaluation by a trained individual. This document is intended to provide a review of the key aspects of diagnostic studies so that there can be a common basis for the committee to discuss pertinent scientific articles. This is not intended to be a comprehensive review of the subject, but instead a more focused discussion. After providing an overview, I will then apply these principles to 2 papers to give examples of the critical appraisal process I go through when reading medical studies. I have attached copies of both papers, 1 of which the committee has already received.

Types of Diagnostic Studies

When reviewing an article about a proposed diagnostic test there are a couple of key terms to identify up front. First is what the proposed test is. This could be a clinical finding (horizontal gaze nystagmus), a lab test (serum THC level), or something more complex (standard field sobriety test, which has multiple elements). The second element is what is referred to as “the gold standard”. This is some independent test or evaluation that identifies when the test under consideration is correct and when it is wrong. A gold standard may be in terms of presence or absence (any detectable THC) or a specific threshold (blood alcohol concentration [BAC] > 0.08%). In either case, the actual test performance is compared to the gold standard to determine how valid the test in question is. Typically, the gold standard is not practical to be performed in a real world setting which is why other tests are developed. Thus, a breathalyzer result is compared to blood alcohol levels because it is more practical to get breathalyzer results in the setting in which a determination needs to be made. One of the issues the committee has faced so far is what the gold standard should be: is this a THC level or a functional degree of impairment assessed in some manner.

There are 2 main types of diagnostic studies: Cohort studies and Case-control studies. A cohort study examines a group of people and compare those with an exposure or finding of some type with those without. A case control study examines a group of people who have a condition (used marijuana) and compares them to another group that lacks the condition (did not use marijuana) and looks at differences between the 2 groups to find features that can predict who will be in each group.

Cohort studies can be done retrospectively or prospectively. Retrospective studies use information from databases or from reviewing charts/files. Retrospective cohort studies are more prone to bias, in part because they are dependent on information already collected. What information was collected and how it was collected are not under the control of the researchers and sometimes missing information has to be inferred in some way. The best kind of study is a prospective cohort study where a specific research plan is established and then followed as subjects are enrolled. All of the necessary data can be collected and the outcomes to be analyzed are established in advance, limiting the opportunity of the researchers to do too many analyses until they find something “significant”. The key properties of a well-done prospective cohort study include all of the following:

1. The population studied should be similar to the one that the test will be used on
2. All participants in the study have both the proposed test and the gold standard performed
3. The study is large enough to have reliable data
4. The details of the proposed test (cut-off level for a blood tests or which clinical findings and how many positives are needed to count) are established at the start of the study.
5. There are not too many outcomes being examined that a positive finding of at least one of them is likely due to a chance result (with one outcome, we use a probability of 5% or less to establish validity; if we look at 20 outcomes, it would not be surprising that at least one of them will be found to be significant if each one has a 5% probability by chance)

Case control studies can also be used for diagnostic purposes but there are 2 things to keep in mind.

1. The controls (those without the condition in question) should be as similar to the cases in as many respects as possible. This includes demographic features such as age, sex and ethnicity as well as any relevant clinical features that could bias the results. For instance, if we were assessing performance on the standard field sobriety test, we would want to make sure that the controls and cases were similar in the frequency of neurologic diseases that might affect performance on some of the testing. While good researchers will control for things they think are important, there is always a possibility that there are unknown factors that affect the results and are not balanced in frequency between the cases and the controls.
2. Unlike a cohort study, you cannot get the prevalence of a condition from a case-control study. This has implications for considering the real-world applicability of the results as will be shown in the next section.

Diagnostic Test Characteristics

Once the study is completed the data then gets analyzed and typically reported using the following terms:

1. Sensitivity is the ability of a test to correctly identify someone with a condition. For our purposes, it is the percentage of people who have used marijuana who test positive. People who have used marijuana and identified are considered True Positives.
2. Specificity is the ability of the test to correctly identify people without the condition. The specificity will be the percentage of those who have not used marijuana who test negative. Those who have not used marijuana and test negative are True negatives
3. Positive Predictive Value (PPV) is the percentage of people who test positive who have used marijuana.
4. Negative Predictive Value (NPV) is the percentage of people who test negative for marijuana who have not used marijuana

Studies often focus on the sensitivity and specificity. However, in real world situations, the PPV and NPV are what is most important. From a criminal justice perspective, we need to know if the test is positive, how likely is it that the result is correct. When considering trying to maintain safe roadways, we also need to know if the test is negative, how likely that is to be correct as well. One problem is that PPV and NPV are dependent on prevalence. In other words, a test may be good, bad or in between depending on how commonly people drive after using marijuana. This may vary depending on whether the setting is a college town or a retirement community. As noted above, you cannot get prevalence from a case-control study. Thus, a case-control study can tell you about the sensitivity and specificity of a test, but cannot reliably give the PPV and NPV. A cohort study can give reliable information about all 4 results.

Illustrative examples

To illustrate these principles, I will review 2 articles. The first is" Drug Recognition Expert (DRE) examination of characteristics of impairment", by Hartman RL et al. from Accident Analysis and Prevention 92 (2016) 219-229. This study assessed the performance of DRE testing in 302 persons with toxicologically confirmed blood THC ≥ 1 mcg/L (cases) and compared this to the performance of 302 non-impaired individuals (controls). The cases were drivers < 60 years old who had a DRE evaluation following a traffic stop. Controls were self-reported drug-negative individuals who did not have toxicology testing done. The study found (all results significant at $p < 0.05$) that cases had higher pulse rate and blood pressure, and larger pupil size. The finger to nose test best predicted cannabis use. Other findings that were abnormal included Modified Rhomberg eyelid tremors, One-leg stand, and Walk-and-turn. The typical performance of these tests was that they were correct around 86% of the time. The best performance was when tests were combined, and at least 2 of the following were abnormal: ≥ 3 misses on finger-to-nose, Modified Rhomberg eyelid tremors, ≥ 2 one-leg stand clues, and ≥ 2 walk-and-turn clues when the performance reached 96.7%. The study also found no difference in cases who had THC ≥ 5 mcg/L and those with THC < 5 mcg/L.

There are several flaws of this study:

1. The gold standard was not applied to all participants since those who were controls did not have toxicology testing.
2. The cases and controls were very different groups. The average age of the cases was 21 while that of the controls was 34. The cases were people who had been arrested at any time of day while the controls were primarily police officers participating in DRE training (which was occurring during normal business hours). Police officers would be expected to be more familiar with the divided attention tasks that are part of the DRE, while the cases were likely hearing these instructions for the first time.
3. In addition, some of the statistics are unreliable. You cannot reliably calculate a positive or negative predictive value from a case control study because the researchers decide what the prevalence of the condition will be (in this case they set it at 50% marijuana positive individuals). The positive predictive value tells you how likely a positive test is to be correct, and if this is not known reliably, it is hard to endorse the test. In addition, they used a cut-off of 1 mcg/L as the threshold for a positive test and it is likely that this would have included those with recent use but not necessarily acute use.
4. Anyone aged 60 years or older was excluded. While this may be reasonable for the study, it means that if this were to be used in Massachusetts, it would not be a validated test for about 20% of the population.

Compare this with the paper "Validation of the Standardized Field Sobriety Test Battery at 0.08% Blood Alcohol Concentration" by Stutster J. in Human Factors Vol. 48, No. 3, Fall 2006, pp. 608–614. This paper evaluated the SFST in motorists as a tool for detecting blood alcohol level > 0.08. A total of 297 people were stopped for suspected operating under the influence of alcohol. A SFST was performed and the officer was asked to state if he/she thought the motorist had a BAC greater or less than 0.08. Then breath or blood testing was performed on all 297 motorists. The breath/blood testing was the gold standard that the SFST was compared to. The SFST had the following diagnostic characteristics: The sensitivity (how many people with BAC > 0.08 were identified) was 90%, the specificity (the number with BAC < 0.08 correctly identified) was 94%, the Positive Predictive Value (the percentage that SFST identified with BAC > 0.08 correctly) was 98%, and the Negative Predictive Value (the percentage that SFST identified as BAC < 0.08 correctly) was71%.

This study has a number of strengths:

1. All participants had the SFST and all had blood alcohol determination so there was no bias of who got tested and who did not.
2. There were no exclusions of any class of motorists. It appears that this represented consecutive cases during the time-period studied although the paper does not state that explicitly.
3. All of the officers were specifically trained by certified instructors in the proper administration of the SFST and no other test besides the BAC measurement was allowed.
4. BAC measurement was only performed after the SFST and after the officer had documented whether they thought the BAC was greater than 0.08 based on the results of the SFST. The officers were required to write down the time each part of the assessment was performed in order to ensure the proper sequence of events.

The study has some limitation as well. The main one being that we have no reporting of demographic data on the subjects who were stopped. This makes it hard to know how confident to be that these results would apply in other settings.

Conclusion

All studies have limitations, some more than others. It is important to review the methods to determine how much confidence we can have in the results. It is not enough to simply report the outcomes of a study. We also need to discuss the quality of the study if it is going to be an important factor in making policy recommendations.

Public Affairs

To:	AAA/CAA PA Contacts
From:	Jennifer Ryan, Director, State Relations
Date:	July 28, 2016
Re:	*AAA State Spotlight*

As of July 28, every state with a legislative session this year has convened, and all but California, Massachusetts, Michigan, New Jersey, Ohio, and Pennsylvania have adjourned.

Contents:

2016: Mid-Year Legislative Review

With only six state legislatures still in session, AAA clubs had a strong presence so far this year. Clubs either led or participated in coalitions that: (1) passed new legislation; (2) strengthened a current law; (3) defended an existing law; or (4) defeated proposals that would have weakened road safety. Traffic safety highlights include:

- **Distracted Driving**
  - Two states, Louisiana and Tennessee increased penalties for distracted driving violations.
  - Virginia expanded its teen wireless ban to learner's permit holders. Wisconsin banned handheld cell phone use in construction zones.
- **Impaired Driving**
  - Maryland, Vermont, and Rhode Island adopted all-offender IID laws, becoming the 26^{th}, 27^{th}, and 28^{th} states to do so.
  - Pennsylvania adopted a law requiring IIDs for offenders with a BAC over .10. Seven additional states have made improvements to existing IID programs by changing program fees, reforming requirements for IID vendors, and further expanding the use of IIDs.
  - A California bill, SB 1046, that would expand the state's all-offender IID pilot program statewide has passed the first chamber.
- **Occupant Protection**
  - The Pennsylvania AAA Federation worked with sponsors in the state to require passengers under age 2 to be secured in a rear-facing restraint.

    - The Auto Club Group fought against a bill that would have weakened the booster seat law in Florida.
    - Clubs also advocated against bills that would repeal universal helmet laws in Missouri, Nebraska and Tennessee.
- **Teen Drivers**
    - AAA clubs in Virginia worked to clarify and strengthen graduated driver's license restrictions in the state.
- **And more**:
    - Maryland also bolstered its penalties for adults violating its social host law by serving or allowing minors to drink alcohol on private property.

For a full list of notable laws enacted so far in 2016, see the charts here.

Protecting Vulnerable Road Users

Even as the overall number of traffic deaths have declined over the past decade, the number of pedestrians and bicyclist fatalities have held relatively constant. According to NHTSA, pedestrians accounted for 15% and bicyclists accounted for 2.2% of traffic fatalities in 2014.

Unlike vehicle-on-vehicle collisions, bicyclists and pedestrians involved in a crash are not protected by crumple zones, seat belts, or airbags. Further, the impact of speed in a collision is even more drastic. The AAA Foundation for Traffic Safety's 2011 report found that the risk of death for a pedestrian struck by a vehicle is 12% at 25 mph, but reaches 75% at 50 mph.

A 2015 survey of state legislators ranked bicycle and pedestrian safety as the fourth most challenging traffic safety issue in their state, only behind drunk, drugged and distracted driving. In May, the NTSB held a forum to better understand why these fatalities are on the rise relative to other traffic fatalities and to learn effective interventions for reversing this trend (webcast available here).

In an effort to increase protection for non-motorized users of public roadways, state legislators have introduced "vulnerable road user" bills. This type of legislation typically defines a vulnerable user – which can also include wheelchairs, skateboards, in-line skates, utility workers, persons riding or being pulled by animals, and farm equipment – and prescribes increased penalties for endangering such users. Bills have also included educational components, such as driver education curriculum changes or funds for public outreach.

Since 2008, at least 14 states have enacted "vulnerable user" laws. A few recent examples are included in the table below. Bills have been introduced in at least eight states in 2016. It is notable that many of these bills closely mirror the League of American Bicyclists' model legislation.

State	Bill	Bill Description
Maine	LD 1301 (2015)	Defines VUs; adds penalties; clarifies law regarding bicyclist behavior; amends driver education curriculum
Connecticut	SB 336 (2014)	Defines VU; specifies penalties
Rhode Island	HB 5061 (2013)	Creates additional penalties for motor vehicle violations that cause serious bodily injury or death
Utah	SB 104 (2013)	Defines VU; specifies penalties
Hawaii	HB 1666 (2012)	Amends penalties when the incident involves VRU
Nevada	AB 328 (2011)	Adds penalties for causing a collision with pedestrian or bike
Oregon	SB 415 (2011)	Increases penalties for injuries to VU in the roadway
Washington	SB 5326 (2011)	Defines VU; creates new traffic infraction; specifies penalties

AAA believes that everyone, across all modes of transportation, needs to share the road safely and responsibly. To improve mobility and reduce traffic crashes, all road users must be aware of and follow the rules of the road. AAA supports a comprehensive approach – public education, engineering, and enforcement – to keep all roadway users safe. However, AAA policy specifies that skateboards, scooters, off-road recreational vehicles, in-line skates, or pocket bikes do not belong on public roadways.

Club Involvement: AAA clubs have primarily monitored vulnerable user legislation, weighing-in only when the bill appears likely to have traction.

- The Auto Club Group provided input regarding Florida SB 332 in 2014, as well as similar iterations of the bill, cautioning that skateboards and the like do not belong on roadways.
- AAA Northern New England remained neutral on LD 1301 in Maine, but worked behind the scenes to address language that overly focused on the motorist instead of everyone's responsibilities.
- AAA Northeast is working on expanding the existing move over law in New Jersey to require vehicles to move over or slow down if a bike or pedestrian was on the side of the roadway.

"Textalyzer" Legislation: Should Police Scan Distracted Driver's Phones?

This spring, a number of media outlets reported on the introduction of a New York bill (SB 6325) that would authorize police to plug a device into a driver's phone to conduct a search, without a warrant, to discover whether the driver was using their phone in violation of state distracted driving laws. Key components of the legislation include:

- Limiting the search to only determining use and specifically excluding any "content or origin of any communication...or image or electronic data."
- Limiting searches to phones of drivers involved in crashes (including property damage-only crashes).
- Establishing "implied consent" for the field testing of their devices. If a driver refuses, their driver's license is suspended for up to a year, or longer for repeat offenses, along with a hefty fine.

This approach, which is meant to help police gather better evidence of distracted driving, is facilitated by the "Textalyzer" - an actual portable product produced by Cellebrite, an Israeli technology company that specializes in data extraction.

The original New York proposal is also known as “Evan’s Law” in memory of 19-year-old Evan Lieberman whose 2011 case illustrates how significant evidentiary problems can arise during an investigation involving distracted driving: the culpable driver’s phone sat in the wrecked car in a junkyard for three months before the phone and the evidence of texting during the fatal crash was uncovered as part of a civil case.

The Textalyzer strategy poses a number of concerns:

- **Likely unconstitutional**. In 2014, the U.S. Supreme Court ruled in *Riley v. California* that "the police generally may not, without a warrant, search digital information on a cell phone seized from an individual who has been arrested” because of the intense privacy interests embodied in modern day smartphones. A traffic stop, even if it does not involve taking physical custody of a person, is technically "an arrest." Were such a law to pass, it would likely be quickly challenged on 4th amendment grounds. The proposal dispenses with the step of acquiring a warrant to prevent ‘clogging the warrant system’ but the warrant process exists for a reason - to avert invasive searches without sufficient probable cause.
- **Unreasonable penalties**. From the motorists' advocate perspective, the 1-year revocation for refusal, equivalent to state laws to suspend drivers' licenses for refusing DUI tests, is inappropriate. The chain of evidence and suspicion leading up to a Textalyzer search would probably not be as rigorous as those leading up to a drunk driving test.
- **Cost**: Potential costs for police departments are uncertain but presumably they would need to purchase many of the devices in order to widely deploy them at the roadside.
- **Other practical hurdles the proposal does not address**:
    - A passenger using a driver’s phone at the time of a crash.
    - Differentiating between handheld use, which is illegal, and hands-free use, which is not.
    - Use of devices while stopped at a stoplight, which may be legal, depending on the state.

This legislation was introduced in January and was reported from its 1st committee (11-2 vote) but failed to advance further before the legislature adjourned. AAA New York has not taken a public position on the bill. Clubs considering whether to weigh in will want to consider the balance in perception between protecting motorists’ privacy and promoting traffic safety.

A similar bill, HB 527, was introduced in Vermont earlier this year to establish general "implied consent" for police to search drivers' phones in distracted driving enforcement situations. AAA NNE was considering whether to oppose the bill, which failed to advance before adjournment. Legislation based on New York’s approach has also been introduced in New Jersey (SB 2297), but has not yet been taken up.

Notably, the seizure of motorists' phones has been a sensitive issue throughout the states as legislators weighed anti-distracted driving proposals. Laws in at least two states, South Carolina and South Dakota, explicitly prohibit police from seizing a driver’s phone when investigating a distracted driving offense.
Contact staff for more information about engaging on “Textalyzer”-type legislative proposals.

Supreme Court: Warrants Needed for DUI Blood Tests

On June 23, the U.S. Supreme Court ruled in the case of *Birchfield v. North Dakota*, consolidated with two other cases (*Bernard v. Minnesota* and *Beylund v. North Dakota)*, that police need to obtain warrants in order to conduct blood tests on impaired driving suspects and may not impose criminal penalties (e.g. criminal fines and jail time) for refusing a blood test without a warrant. On the other hand, because breath tests implicate weaker privacy concerns, no warrant is required and criminal penalties may be imposed for refusing. This aims to strike a balance to preserve much of the states' ability to combat drunk driving. To summarize:

	Warrant Required?	Criminal Penalties for Test Refusal Allowed?
Breath Test • Little significant privacy concerns • Non-invasive, no sample stored • Provides only information • Warrants would be mostly the same; nothing for magistrates to weigh	No	Yes
Blood Test • Major privacy concerns • Intrusion on driver's body • Sample collected and stored • Police can use less-invasive option (breath testing)	Yes	No

In the wake of this ruling, undoubtedly states involved in blood testing are likely doing a quick scramble to make sure police and prosecutors know about the decision and when warrants are and aren't required. In the long term, states may begin shifting more towards DUI breath testing to avoid having to always obtain warrants for blood draws and adopting electronic warrant systems to expedite the warrant process.

Currently, thirteen states have laws on the books that impose criminal penalties for DUI test refusal. These states may look to formally shore up their statutes in the 2017 legislative session to align with the court's decision.

The Association updated its Policy last year to recommend that states make penalties for test refusal, including criminal penalties, substantively equivalent to or greater than penalties for a DUI conviction. This helps remove any incentives for offenders to refuse testing if they think they will face lesser sanctions. The Court's decision creates a new framework that states will need to work around in order to continue to curb the refusal rate.

While this decision impacts criminal penalties for refusal, all states still impose administrative penalties (e.g. license suspension) and may continue to do so as administrative consequences were not addressed in the ruling.

Finally, as drugged driving toxicology cannot (yet) rely on breath testing, police will need to obtain a warrant to draw blood samples. If not, lack of criminal penalties would incent drivers to refuse the test.

Save the Date: 2016 AAA/CAA Public Affairs Conference

Plans are underway for a dynamic and impactful AAA/CAA Public Affairs Conference September 13-15, 2016 at the Hyatt Regency Minneapolis in Minneapolis, Minnesota. Please join us for:

- An Association Update from Bob O'Keefe, Executive Director, AAA Strategy, Brand and Membership and a AAA Public Affairs Update from Kathleen Bower, Vice President, AAA Public Affairs.
- Keynote address by leading pollster Peter Hart on the 2016 national elections.
- A presentation from former NHTSA Administrator David Strickland on automotive technology and the future of autonomous cars.
- General sessions on the future of mobility, trends in drug-impaired impaired driving, the changing media landscape, as well as breakout sessions focused on topics of interest to public affairs professionals.

For more information, contact Michelle Paris at mparis@national.aaa.com or (202) 942-2068.

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US Traffic Fatalities, 1985–2014, and Their Relationship to Medical Marijuana Laws

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Objectives. To determine the association of medical marijuana laws (MMLs) with traffic fatality rates.

Methods. Using data from the 1985–2014 Fatality Analysis Reporting System, we examined the association between MMLs and traffic fatalities in multilevel regression models while controlling for contemporaneous secular trends. We examined this association separately for each state enacting MMLs. We also evaluated the association between marijuana dispensaries and traffic fatalities.

Results. On average, MML states had lower traffic fatality rates than non-MML states. Medical marijuana laws were associated with immediate reductions in traffic fatalities in those aged 15 to 24 and 25 to 44 years, and with additional yearly gradual reductions in those aged 25 to 44 years. However, state-specific results showed that only 7 states experienced post-MML reductions. Dispensaries were also associated with traffic fatality reductions in those aged 25 to 44 years.

Conclusions. Both MMLs and dispensaries were associated with reductions in traffic fatalities, especially among those aged 25 to 44 years. State-specific analysis showed heterogeneity of the MML–traffic fatalities association, suggesting moderation by other local factors. These findings could influence policy decisions on the enactment or repealing of MMLs and how they are implemented. (*Am J Public Health.* 2017;107:336–342. doi:10.2105/AJPH.2016.303577)

In the past 2 decades, 23 US states and the District of Columbia have enacted laws allowing the use of cannabis (marijuana) to treat certain medical conditions.[1] Despite potential benefits of legislation protecting the medical use of marijuana, concern is increasing that medical marijuana laws (MMLs) may increase nonmedical marijuana use and the number of individuals driving under the influence of marijuana, and thus increase the rate of traffic injuries.[2]

Some simulator and on-road experimental studies show a dose-dependent association between marijuana exposure and several indicators of driving impairment.[3] Studies show that marijuana exposure is associated with increased response time and lane weaving.[4,5] In addition, it has been associated with impairment in other complex tasks requiring neurocognitive and neuromotor skills[6,7] that are likely to be involved in driving safely. Marijuana exposure has also been associated with reduced speed and greater headway,[4,8] which indicates some degree of awareness of marijuana-related impairment and a tendency to compensate.[8]

Despite these observations, population-based data have not shown an increase in traffic fatalities following medical marijuana legalization. A study that used 1990–2010 Fatality Analysis Reporting System (FARS) data showed that, contrary to expectations, MML enactment was associated with a reduction in the rates of traffic fatalities in the overall population (10.4% reduction), mainly because of a reduction in alcohol-related traffic fatalities.[9] These findings suggest that MML enactment could have contributed to an increase in marijuana use and lowered the use of alcohol, consistent with the substitution hypothesis,[10] in these states, partially explaining the reduced alcohol-related incidents observed.

Previous research[11] also shows that MMLs are heterogeneous across states, and that certain aspects of these laws, such as allowances on home cultivation or dispensaries, might be important to take into account when one is assessing the association between MMLs and different health outcomes. For example, a previous study showed that authorization of dispensaries in MML states was associated with treatment admissions in which marijuana is the primary substance of abuse.[11] One study to date has found evidence of dispensary legal provisions in MML states to be associated with an increase in traffic fatalities,[12] but the study did not examine the association between the actual presence of operational dispensaries (i.e., having an operating dispensary system even if not officially sanctioned) and traffic fatalities. Examining the role of operational dispensaries would provide additional information on whether increases in marijuana availability via dispensaries lead to changes in fatality rates.

We investigated the association between MML enactment and change in traffic fatalities, making use of a wider range of the FARS data, years 1985 to 2014, and including 9 additional states enacting MMLs between 2010 and 2014. We examined whether the

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rate of traffic fatalities changed following MML enactment in 1985 to 2014, if the magnitude of the association differed by state, and if estimates were robust to different model specifications and to the inclusion of potential confounders in the model. In addition, we explored the specific role of operational medical marijuana dispensaries on traffic fatality rates.

METHODS

Data came from the FARS, a nationwide census of traffic fatalities information maintained by the National Highway Traffic Safety Administration. Briefly, this data set provides data on individuals fatally injured in motor vehicle crashes on public roads in the United States who died within 30 days of the crash.[13] Data include driver characteristics such as age, gender, and race. We obtained the aggregated FARS data from different sources including police accident reports, death certificates, coroner or medical examiner reports, hospital medical reports, state highway department data, emergency medical services records, vital statistics, and other state records.[13] Trained analysts collected the data by using standardized protocols that automatically check for acceptable range values and consistency.[13] We used FARS data from years 1985 to 2014, enabling us to include at least 10 years of pre-MML data for all states enacting these laws. We did not include the District of Columbia in the analyses.

Measures

Traffic fatalities. Our outcome of interest was the rate of traffic fatalities across time. We obtained the total number of fatally injured road users, including drivers, passengers, cyclists, and pedestrians, by year, state, and age group (entire population, and those aged 15–24, 25–44, and ≥ 45 years) from FARS. We obtained state populations for each year, state, and age group used to calculate fatality rates for each state from the Web-based Injury Statistics Query and Reporting System of the Centers for Disease Control and Prevention.[14] In analyses for the entire population, we used age-adjusted traffic fatality rates based on the 2000 US population.

Enactment and effective date of medical marijuana laws. Our main exposure was the enactment of MMLs by state, as defined by legal scholars, economists, and policy analysts at RAND Corporation[15] (Table A, available as a supplement to the online version of this article at http://www.ajph.org). First, we coded the MML variable as a time-varying (i.e., allowed to change over time), 3-category variable. The 3 categories were before, after, and never. States enacting medical marijuana laws were coded as "before" for the years before the enactment of the laws, and as "after" for years after. For example, because Vermont enacted its MML in 2004, this state is coded as "before" for years 1985 to 2003 and as "after" for years 2004 to 2014. As MMLs are enacted in different months, if the law was enacted between January 1 and June 30, we coded the year of MML enactment as "after," because the state was exposed to the MML for at least half of the year in which it was enacted. Alternatively, if the MML was enacted between July 1 and December 31, we coded the year of MML enactment as "before," because the state was exposed to the MML only for the second half of the year. States without MMLs up to 2014 were coded as "never" for all years.

We also used the date when MMLs became effective, when the statutory obligation commences in each state, rather than the date enacted. We used the same coding strategy as the one used for enactment dates.

Operational dispensaries. We coded the presence of operational dispensaries in MML states as a time-varying, 3-category variable in a similar way as we did for our MML variable—before, after, and never—on the basis of previous[11,16] and recent information provided by researchers at RAND Corporation. States with MMLs were coded as "before" for years before they had operational dispensaries, and were coded as "after" for years when the state had legally operating dispensaries. This is when legislation was passed allowing marijuana sales and also an operational regulatory and distribution regime,[16] or if the state had a functional dispensary system, even if not officially sanctioned[16] (Table A). States without dispensaries were coded as "never" for all years.

Covariates. We adjusted our analyses for time-varying state characteristics and state legislation used in previous research.[9] State-level covariates included unemployment rate and median household income, speed limits of 70 miles per hour or greater,[17] primary seat belt laws enforcement, laws decriminalizing the possession of small amounts of marijuana, and whether states had enacted a recreational marijuana law.[18,19] The later 4 covariates were coded as "1" if the state had the law in any given year and "0" otherwise. We also controlled for state-level graduated driver license laws,[20] blood alcohol content laws (0.08 g/dL), drug per se laws,[21] administrative license revocation laws,[22] and laws banning cell phone use and texting while driving, separately targeting adolescents and adults.[23] These later 5 covariates were coded as "1" if the state had the law in any given year and "0" otherwise; also, if the enactment of the law occurred during a calendar year, we coded that year as the proportion of the year the law was in effect. In addition, we included a measure of state annual expenditures for highway law enforcement and safety per capita (adjusted to 2000 dollars), and also a state measure of the annual vehicle miles driven per licensed driver (thousands of miles) from Highway Statistics, US Department of Transportation (both covariates log transformed).

Because alcohol consumption can be a confounder of the association between MML and traffic fatalities, we also explored the robustness of estimates when we controlled for a measure of the state-level per capita ethanol sales, total ethanol of all beverages combined per population aged 21 years or older (log transformed) from the Surveillance Reports of the National Institute on Alcohol Abuse and Alcoholism. Results are presented in Table B, available as a supplement to the online version of this article at http://www.ajph.org. However, because changes in ethanol sales could be a mechanism through which MML influences traffic fatalities, all results provided, except when indicated, are from models not including this covariate.

Statistical Analyses

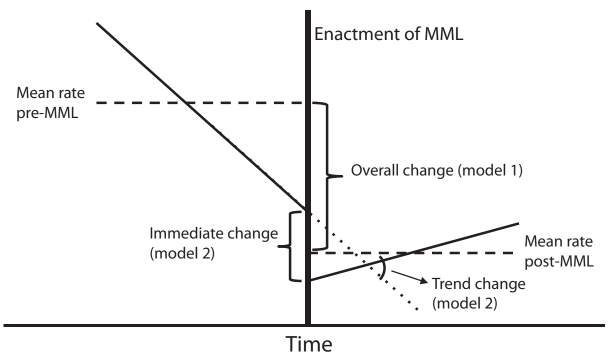
To examine whether MMLs were associated with changes in the natural logarithm of the rate of traffic fatalities, we used linear multilevel regression models[24] with state-level random intercepts. This main effect model, which used the 3-category MML as the exposure variable, allowed us to determine the change in the rate of fatalities within states before and after MML enactment (Figure 1: overall change, model 1) while taking into account the rates in states that did not enact MMLs. In addition, we used a piecewise cubic spline[25] with a knot at 2007 to control for the nonlinearity of national trends in traffic fatality rates; this allowed us to control for any national events that could have influenced traffic fatality rates across states over time. All models were stratified by age group, weighted by the state population, and adjusted for covariates. The percent change in fatality rates associated with the enactment of MMLs was estimated with the equation,

(1) % change = (1—exp[estimate difference between pre/post MML rates]) × 100%.

To estimate the yearly variation in the rates of traffic fatalities after the enactment of MMLs, we used an alternative model strategy by including linear trends for years before and after the enactment of MML for states with these laws.[26] In this “hybrid” model, the estimate for the 3-category MML variable represents the “immediate” change in the rate soon after MMLs are enacted, and the “trend” effect represents the change in the linear trend, from the pre-MML to the post-MML period[26] (Figure 1). The hybrid model can be useful to identify a change in the trend in cases such as the one presented in Figure 1, when a marked decreasing trend in traffic fatalities in the pre-MML period is followed by an immediate reduction and then by a gradual increasing trend in traffic fatalities in the post-MML period. In this scenario, the main effect model would show an overall reduction in traffic fatalities associated with MML despite the change in the trend. The pattern in Figure 1 could emerge if, for example, the enactment of MML is followed by stronger police enforcement soon after the enactment that would result in an immediate reduction in traffic fatality rates; however, a possible gradual increase in the prevalence of marijuana use after enactment of MMLs could result in a gradually increasing prevalence of driving while intoxicated, leading to a gradual increase in traffic fatalities.

We also examined the association between operational dispensaries and traffic fatalities by using similar models as described previously adjusted by covariates and also by the time-variant MML variable indicating whether states had or had not enacted MMLs.

Finally, we examined the state-specific association between MMLs and traffic fatalities in the entire population (i.e., all ages) by including state as a fixed effect in models, both in the main effect and hybrid models, with interaction terms (1) between MML and states, and (2) between pre–post-MML trends and states; in this model we dichotomized the MML variable as “1” in years in which states had a MML, and “0” otherwise. This provided us the before–after comparison and the change in trends separately for each state that passed MMLs. We performed statistical analysis with SAS version 9.4 (SAS Institute Inc, Cary, NC).



Note. MML = medical marijuana law.

FIGURE 1—Model Estimates With a Main Effect Model Strategy (Model 1) and With a Hybrid Model Including Immediate and Trend Effects (Model 2) to Examine the Association Between Medical Marijuana Laws and Traffic Fatalities, United States, 1985–2014

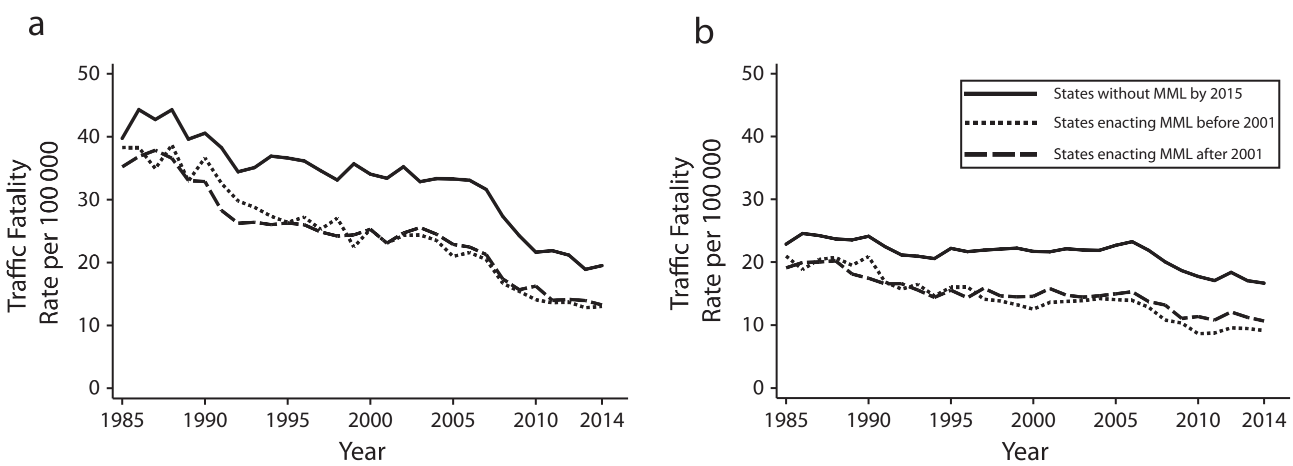
RESULTS

A total of 1 220 610 deaths attributable to traffic crashes occurred in the 50 states during the study period (1985–2014). We observed a reduction in the age-adjusted (2000 US population) national rate of traffic fatalities from 1985 (17.8 per 100 000) to 2014 (10.0 per 100 000). Although, on average, states enacting MMLs had lower rates of traffic fatalities compared with states without MMLs (26.3% lower; 95% confidence interval [CI] = 13.9%, 36.9%) states with and without MMLs followed a similar trend pattern toward reductions in traffic fatality rates (Figure 2). Among individuals aged 24 to 44 years, the trend for states enacting MMLs before 2001 slightly deviated during 1996 to 2000, the period in which these states enacted their MMLs, from that of states enacting MMLs after 2001.

Medical Marijuana Law Enactment and Traffic Fatality Rates

Results from main effect models for the entire population (i.e., all ages) showed that, among states passing MMLs, the mean traffic fatality rate in the pre-MML period (12.1 per 100 000) was significantly higher than that in the post-MML period (11.2 per 100 000), indicating a reduction of 10.8% (95% CI = 9.0%, 12.5%; % reduction = [1 − exp(−0.114)] × 100) in traffic fatality rates (Table 1). Similarly, we observed a reduction of 11.0% (95% CI = 8.5%, 13.5%), 12.0% (95% CI = 9.5%, 14.3%), and 9.0% (95% CI = 6.9%, 11.0%) among those aged 15 to 24 years, 25 to 44 years, and 45 years and older, respectively (Table 1).

In hybrid models for the entire population, the immediate effect (i.e., sudden change in fatality rate after MML enactment), indicated that there was an immediate reduction of 3.5% (95% CI = 1.1%, 5.8%), whereas the gradual effect (i.e., change in rate trend after MML enactment) was not significant (Table 1). For those aged 15 to 24 and 25 to 44 years, there were also similar immediate reductions in traffic fatalities as those observed in the entire population. Among those aged 25 to 44 years, the gradual effect was also negative and significant (difference in pre–post MML trends = −0.005; $P < .01$). We observed no significant reductions among those aged 45 years or older in hybrid models (Table 1).



Note. MML = medical marijuana law. Linear trends (estimate and *P* value). Group aged 15–24 years: states without MMLs by 2015 (–0.75; *P* < .001); states enacting MMLs before 2001 (–0.88; *P* < .001); and states enacting MMLs after 2001 (–0.76; *P* < .001). Group aged 25–44 years: states without MMLs by 2015 (–0.20; *P* < .001); states enacting MMLs before 2001 (–0.40; *P* < .001); and states enacting MMLs after 2001 (–0.28; *P* < .001). Figures for all age groups are provided in Figure A, available as a supplement to the online version of this article at http://www.ajph.org.

FIGURE 2—Traffic Fatality Rates Across States Enacting Medical Marijuana Laws and Those Without Medical Marijuana Laws by 2014 Among Those Aged (a) 15–24 Years and (b) 25–44 Years: United States, 1985–2014

Operational Dispensaries and Traffic Fatality Rates

Results from main effect models showed that dispensaries were associated with a significant reduction in traffic fatalities in those aged 25 to 44 years (5.1%; 95% CI = 1.5%, 8.6%), and a nonsignificant reduction in the entire population (2.7%; 95% CI = –0.01%, 5.3%; Table 1). In hybrid models, the immediate effect and gradual effects were not significant for any of the age groups (Table 1).

In the main effect models, further control for the state-level per-capita ethanol sales (log transformed) covariate reduced the magnitude of the association between MMLs and traffic fatalities by 20% to 22% across age groups, although estimates remained significant at a 95% confidence level (Table B). Hybrid models were not impacted by the inclusion of this ethanol sales covariate.

Results for the association between "MML effective date" variable and traffic fatality rates were almost identical to those described previously for the "MML enactment date" variable (Table C, available as a supplement to the online version of this article at http://www.ajph.org).

Estimates for Individual States

Results from the main effect model show that in 7 states (California, Oregon, Washington, Colorado, Nevada, New Mexico, and Arizona) the MML enactment was significantly associated with a reduction in traffic fatality rates, whereas in 2 states (Rhode Island and Connecticut) MMLs were associated with an increase in rates (Table 2).

In hybrid models, only 4 states showed significant associations: California showed an immediate post-MML reduction of 16.0% in traffic fatalities (95% CI = 12.0%, 20.0%) followed by a gradual yearly increase (difference in pre–post-MML trends = 0.013; *P* < .01); similarly, New Mexico had an immediate post-MML reduction of 17.5% (95% CI = 1.4%, 31.0%) and significant post-MML gradual increase in traffic fatalities (difference in pre–post-MML trends = 0.049; *P* < .01); Colorado had a nonsignificant immediate increase and a yearly significant reduction in fatality rates (difference in pre–post-MML trends = –0.022; *P* < .05); and Michigan had a positive immediate increase of 14.2% in traffic fatalities (95% CI = 4.7%, 24.5%) and a nonsignificant trend effect (Table 2).

DISCUSSION

Using population-based data from 1985 to 2014, we found that, first, states that enacted MMLs during the study period had lower fatality rates compared with states without MMLs. Second, on average, traffic fatalities further decreased in states post-MML, with both immediate (sudden change in fatality rate after MML enactment) and gradual (change in rate trend after MML enactment) declines over time in those aged 25 to 44 years. Third, the association between MML and traffic fatalities varied considerably across states. Fourth, the presence of operational dispensaries was also associated with reductions in traffic fatalities in those aged 25 to 44 years.

We found that, on average during the study period, MML states had lower traffic fatality rates than non-MML states. It is possible that this is related to lower levels of alcohol-impaired driving behavior in MML states. Evidence from the Behavioral Risk Factor Surveillance Systems data from 2000[27] and 2012[28] shows that states that have enacted MMLs, compared with non-MML states, had, on average, lower proportions or rates of drivers endorsing having driven after having too much to drink. In addition, other unmeasured characteristics, including strength of public health laws related to driving, infrastructure characteristics (e.g., high-technology roads), or quality of health care systems, may partially explain these findings.

TABLE 1—Estimate of the Association Between the Enactment of State Medical Marijuana Laws, Operational Dispensaries, and States' Traffic Fatality Rates (Natural Logarithm) by Age Group: United States, 1985–2014

	Rate Difference[a] (95% CI)			
Effect	Age 15–24 Years	Age 25–44 Years	Age ≥45 Years	All Ages
Medical marijuana laws				
Main effect	−0.117 (−0.145, −0.089)	−0.127 (−0.155, −0.100)	−0.095 (−0.117, −0.072)	−0.114 (−0.134, −0.094)
Hybrid model				
Immediate effect	−0.059 (−0.095, −0.023)	−0.040 (−0.075, −0.006)	−0.020 (−0.048, 0.008)	−0.036 (−0.060, −0.011)
Trend effect	0.002 (−0.002, 0.005)	−0.005 (−0.009, −0.002)	−0.0001 (−0.003, 0.003)	−0.001 (−0.004, 0.001)
Operational dispensaries				
Main effect	−0.006 (−0.045, 0.033)	−0.053 (−0.090, −0.015)	−0.024 (−0.055, 0.007)	−0.027 (−0.055, 0.0001)
Hybrid model				
Immediate effect	0.008 (−0.038, 0.055)	−0.002 (−0.047, 0.043)	0.016 (−0.019, 0.052)	0.014 (−0.017, 0.046)
Trend effect	0.007 (−0.0004, 0.014)	−0.005 (−0.012, 0.017)	−0.0001 (−0.006, 0.006)	−0.001 (−0.006, 0.004)

Note. CI = confidence interval; MML = medical marijuana law. All models are adjusted by the national trend of vehicle miles driven per licensed driver and the following state-level covariates: population size, unemployment rate, median household income, speed limits of 70 mph or greater, primary seat belt enforcement laws, graduated driver license laws, blood alcohol content laws, drug per se laws, administrative license revocation laws, highway law enforcement and safety expenditures, decriminalization of marijuana laws, recreational marijuana laws, bans on texting and cell phone use while driving laws targeting adolescents and adults, and annual miles driven per licensed driver. All models were multilevel random intercept regression models with random intercepts for states and a cubic form of time with a piecewise linear spline with a knot at 2007.

[a]Log scale.

Our study also shows that, on average, MMLs were associated with an overall reduction in traffic fatalities in main effect models. In addition, in hybrid models, we found immediate and gradual reductions only among those aged 25 to 44 years, a group representing a great percentage of all registered patients for medical marijuana use,[29] and a group showing increases in the prevalence of marijuana use in association with the enactment of MMLs.[30] Interestingly, we did not find strong evidence suggesting reductions among those aged 45 years and older, which is also a group overrepresented in the population of patients registered in state medical marijuana programs.[29] This suggests that the mechanisms by which MMLs reduce traffic fatalities mostly operate in those younger adults, a group also frequently involved in alcohol-related traffic fatalities; in 2004 and 2013, 47% of fatally injured drivers with a blood alcohol content of 0.08 or greater were aged 25 to 44 years.[31]

There may be different mechanisms by which MMLs may reduce traffic fatalities. Some evidence suggests[9] that MMLs may increase marijuana use in the population and, consistent with the substitution hypothesis,[10] reduce the prevalence of alcohol consumption that, in turn, would result in lower rates of alcohol-related traffic fatalities. Anderson et al.[9] found reductions in traffic fatalities in which at least 1 driver was positive for any alcohol in the blood (marginally, $P < .1$) and those with blood alcohol concentrations greater than or equal to 0.1 grams per deciliter ($P < .05$), and also reductions in traffic fatality rates occurring on weekends, which are more likely to be alcohol-related than those on weekdays.

If MMLs reduce traffic fatalities by reducing alcohol-related deaths, it is expected that these reductions would have been gradual given that MMLs are likely to gradually increase the availability of marijuana as dispensaries are opened and the number of patients getting access to medical marijuana increases, for example, as described for patient registries across MML states.[29] However, immediate reductions may also occur if the enactment of MMLs produces rapid changes in attitudes toward marijuana use in the overall population, reducing perceptions of risk associated with marijuana use. In addition, immediate reductions can be the result of stronger preventive police enforcement actions targeting weekend drivers occurring soon after the enactment of MMLs. In this regard, because few registered patients for medical marijuana are aged 15 to 24 years[29] and also because MMLs had not been found to be associated with marijuana use in individuals aged 25 years or younger[30] nor in adolescents,[32,33] it is possible that the immediate reduction we observed in the hybrid model for those aged 15 to 24 years is related to external control measures, such as stronger police enforcement actions.

Our findings for specific state associations suggest that not all MML states experienced reductions in traffic fatality rates, but few actually experienced increases. Although results from main effects models suggest beneficial reductions in traffic fatalities for 7 states, in the hybrid model, only Colorado showed a significant yearly reduction in traffic fatalities. In California and New Mexico, after an initial immediate reduction, MMLs were actually associated with gradual increases in fatality rates. These findings provide evidence of the heterogeneity of MML–traffic fatalities associations across states and indicate the need for further research on the particularities of MML implementation at the local level and the interaction of MMLs with other aspects that may influence traffic fatality rates.

Finally, results from our operational dispensaries analyses, at least from the main effect model, support the initial findings that MMLs were associated with reductions in traffic fatalities among those aged 25 to 44 years and suggest that this may in part occur via increases in marijuana availability.

Limitations

Limitations are noted. First, we described an overall association between MMLs and traffic fatalities, but we are uncertain of what the causal chain may be. This study adds to

TABLE 2—Estimate of the Association Between the Enactment of State Medical Marijuana Laws and States' Rate of Traffic Fatalities (Natural Logarithm) by State: United States, 1985–2014

State	Rate of Traffic Fatalities, 1985	Rate of Traffic Fatalities, 2014	MML on Traffic Fatality Rates, Model 1, Main Effect (SE)	MML on Traffic Fatality Rates, Model 2, Hybrid Model: Immediate Effect (SE)	MML on Traffic Fatality Rates, Model 2, Hybrid Model: Trend Effect (SE)
California	17.95	7.72	−0.199** (0.014)	−0.175** (0.024)	0.013** (0.004)
Oregon	20.6	8.5	−0.226** (0.037)	−0.053 (0.067)	0.008 (0.008)
Washington	16.59	6.34	−0.217** (0.030)	−0.008 (0.054)	0.0002 (0.007)
Alaska	23.42	9.93	−0.116 (0.083)	0.168 (0.152)	−0.007 (0.018)
Maine	17.12	9.16	0.035 (0.058)	0.048 (0.106)	0.002 (0.012)
Colorado	17.57	8.95	−0.068* (0.032)	0.089 (0.059)	−0.022* (0.007)
Nevada	26.75	10.08	−0.198** (0.054)	0.003 (0.089)	0.008 (0.010)
Hawaii	11.6	6.55	0.040 (0.059)	0.019 (0.108)	−0.013 (0.013)
Maryland	15.74	7.34	0.001 (0.03)	0.028 (0.052)	−0.003 (0.007)
Montana	27.1	18.92	0.052 (0.071)	−0.020 (0.125)	−0.011 (0.019)
Vermont	20.91	6.44	−0.122 (0.086)	0.050 (0.153)	0.003 (0.022)
Rhode Island	10.4	4.44	0.179* (0.070)	0.111 (0.121)	0.011 (0.021)
New Mexico	36.24	18.58	−0.243** (0.053)	−0.193* (0.091)	0.049** (0.018)
Michigan	16.7	8.85	0.0001 (0.027)	0.132** (0.044)	0.021 (0.013)
New Jersey	12.29	5.99	0.023 (0.030)	0.077 (0.048)	−0.010 (0.017)
Arizona	27.47	11.17	−0.195** (0.039)	−0.029 (0.060)	−0.024 (0.028)
Delaware	15.92	12.59	0.103 (0.101)	−0.044 (0.159)	0.040 (0.075)
Connecticut	13.19	6.8	0.169** (0.062)	0.162 (0.088)	−0.024 (0.060)
Massachusetts	11.81	4.67	−0.020 (0.055)	0.034 (0.069)	0.027 (0.088)
Summary[a]					
Increase—significant			2	1	2
Reduction—significant			7	2	1
Increase—not significant			7	10	9
Reduction—not significant			3	6	7

Note. MML = medical marijuana law. Model 1: linear regression model with interaction term between MML and state, adjusted by a cubic form of time with a piecewise linear spline with a knot at 2007, and covariates. Model 2: linear regression model with interaction terms between MML and state, interaction terms between pre–post-MML trends and states, and adjusted by a cubic form of time with a piecewise linear spline with a knot at 2007, and covariates. All models are adjusted by the national trend of vehicle miles driven per licensed driver and the following state-level covariates: population size, unemployment rate, median household income, speed limits of 70 mph or greater, primary seat belt enforcement laws, graduated driver license laws, blood alcohol content laws, drug per se laws, administrative license revocation laws, highway law enforcement and safety expenditures, decriminalization of marijuana laws, recreational marijuana laws, bans on texting and cell phone use while driving laws targeting adolescents and adults, and annual miles driven per licensed driver.

[a]In the summary section, significance is based on $P < .05$.

*$P < .05$; **$P < .01$.

evidence of the association between MMLs and traffic fatalities, laying the groundwork for future studies on specific mechanisms. Moreover, our data suggest that one mechanism is through increases in marijuana availability as dispensaries become operational. Second, because we used state-level aggregate data, we could not observe whether associations vary across different cities or counties. However, our study provides state-level estimates, the level at which MMLs are enacted. Further research at local levels will improve our understanding of how MML aspects and also other factors relate to traffic fatalities.

Third, we did not examine other variations in medical marijuana laws (e.g., home cultivation, approved illnesses) in our models that could also have an effect on traffic fatalities. However, we examined the additional effect of operational dispensaries, an important factor increasing the availability of marijuana. Fourth, for states enacting MMLs after 2010, we had only short post-MML periods, which limited the identification of long-term effects in these states.

Fifth, we could not examine whether MMLs were associated with increments in the rates of traffic fatalities in which drivers tested positive for the presence of cannabis metabolites in blood. Testing procedures vary by state and our own exploration of FARS data showed that only a limited number of states tested 80% or more of their fatally injured drivers. In addition, the FARS coding system does not differentiate between active and inactive cannabinoid metabolites[34] and, therefore, it is not possible to know whether the driver was driving under the influence of marijuana. Sixth, we used data on traffic fatalities, the most extreme injury outcome; therefore, we cannot make any observations on the association between MMLs and nonfatal traffic injuries.

Finally, our measure of per-capita alcohol consumption may not fully capture varying alcohol consumption patterns in the population, and is not informative about specific age groups. However, per-capita alcohol consumption data have moderate to strong correlations with survey measures of drinking, heavy drinking, and binge drinking,[35] and this indicator of overall alcohol consumption in the United States has been a long-term National Institutes of Health indicator of time trends in drinking.

Implications

Our study suggests that, on average, MMLs are associated with reductions in traffic fatalities, particularly pronounced among those aged 25 to 44 years, a group representing a great percentage of all registered patients for medical marijuana use,[29] and with increased prevalence of marijuana use after the enactment of MMLs.[30] Although increases in marijuana use following the establishment of marijuana dispensaries could reduce the occurrence of alcohol-related mortality by reducing the number of drivers driving under the influence of alcohol, other simultaneous factors at the state and local levels also may be responsible for these changes in traffic fatalities. Our findings show great heterogeneity of the MML–traffic fatalities associations across states, suggesting the presence of these other mechanisms. This is important for policy development and for the debate of the enactment or repealing of MMLs, given that alternative local strategies such as stronger police enforcement and programs aiming to reduce impaired driving involving any substance use could be local factors linked to reductions in traffic fatalities in MML states. AJPH

CONTRIBUTORS

J. Santaella-Tenorio developed the design and conceptualization of the study, collected and analyzed the data under supervision of M. M. Wall and C. M. Mauro, interpreted the results, and wrote the original draft of the article. J. H. Kim, C. M. Mauro, and S. S. Martins contributed to the design and conceptualization of the study and to the interpretation of results and helped draft the article. M. M. Wall, M. Cerdá, K. M. Keyes, D. S. Hasin, and S. Galea contributed to the interpretation of results and helped draft the article.

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HUMAN PARTICIPANT PROTECTION

Ethics approval was not needed for this work because it used publically available, de-identified data.

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Oral fluid

Efficacy of Oral Fluid Testing - Two Prone Impairment Based on Observations (Signs) and Verification with Oral Fluids:

Logan B. The Science of Oral Fluid Testing and its Current Applications in Drugged Driving. Investigation, Interagency Task Force on Drunk Driving, Feb, 2014 [196]

• Evaluation of 12 roadside oral fluid testing devices, ranking for cut-off, performance, reliability/robustness

• Three viable options: Dräger DT5000, DrugWipe5, Alere DDS2

• Sensitivity, Specificity, Accuracy, Positive Predictive Value and Negative Predictive Value for Dräger and DrugWipe devices for all rated drug classes compared with lab based oral fluid testing

• Per se and zero tolerance laws are ineffective and unworkable for THC in states with legal medical or recreational marijuana. ***Impairment has to be demonstrated and documented, along with signs that relate it to cannabinoid ingestion. Oral fluid testing fulfills that final requirement.***

Oral Fluid Test Allowed as Evidence at Trial:

California vs. Salas. Superior Court, Kern County, CA, November, 2015 [352] Transcript of Kelly hearing with respect to Dräger DT 5000. ***Affirms that evidence from the Dräger DT 5000 roadside oral fluid testing device is sufficiently reliable to be admitted to a jury.***

Oral Fluid Results & DRE Evaluations Consistent with DRE Results:

Anderson W. Oral Fluid Drug Testing in DUID Cases NMS, 2013 [184]

• This duplicates much of the Logan IATFDD presentation (#20)

• ***Compares Dräger sensitivity, specificity and accuracy vs. both oral fluid laboratory testing and vs blood testing***

• Reports results of Los Angeles testing of ***Dräger device vs. laboratory oral fluid testing, showing excellent sensitivity and specificity; results support DRE opinions but sensitivity was poor for benzodiazepines and some opiates can be missed.***

Oral Fluid Not Perfect – Practical to I.D. OUID Proximate to Traffic Stop:

Flannigan J, Talpins S, Moore C. Oral Fluid Testing for Impaired Driving Enforcement. The Police Chief. January 2017 [406] 112

• Article discusses Frye/Daubert requirements for admissibility and recommends use of oral fluid roadside testing devices.

• ***On-site oral fluid testing devices are not perfect; however, they provide a viable and cost-effective way to identify drugged drivers proximate to the traffic stop. The authors recommend that officers screen all impaired drivers for drugs using on-site devices***.

DRE Impairment Results Consistent with Lower THC Levels:

Logan B. An Evaluation of Data from Drivers Arrested for Driving Under the Influence in Relation to *per se* Limits for Cannabis, AAA Foundation for Traffic Safety, May, 2016 [335]

Results of two studies:
1) a controlled study of 602 drivers arrested for impaired driving in which only THC was present, and

2) THC and other drugs present in 17,612 DUI cases, 13,988 of which were cannabinoid positive. Full DRE exam reports were assessed in the former study.
There were minimal DRE performance differences between subjects < 5 ng/ml THC and those* less than *5 ng/ml THC.
• "Based on this analysis, a quantitative threshold for *per se* laws for THC following cannabis use cannot be scientifically supported." 58.3% of 11,328 DUI cases confirmed positive for THC had levels below 5 ng/ml.
• Marijuana is only one component of a larger DUID problem.

Time of Dosing & Chronic Users Can Become Durably Impaired:

Huestis M. Acute vs Chronic Frequent Cannabis Intake, ACMT Seminar in Forensic Toxicology, Denver, CO, December, 2015 [299]

• ***Attempts have been made to determine time of dosing based upon blood test results, but with only limited success.***

• ***Frequent cannabis smokers can become durably impaired, even after abstinence.***

Difference Between Alcohol & Marijuana Impairment Using Blood Concentrations:

Banta-Green C. Overview of Major Issues Regarding the Impacts of Alcohol and Marijuana on Driving, AAA Foundation for Traffic Safety, March, 2016 [325]

A tabular comparison of alcohol and THC. The differences are so great as to prevent reliance upon DUI-alcohol methods to deal with DUI-THC, such as blood concentrations to determine levels of impairment.

Fatal Crashes – Active THC & THC Concentration:

Tefft BC, Arnold LS, Grabowski JG. Prevalence of Marijuana Involvement in Fatal Crashes: Washington 2010-2014 May 2016 AAA Foundation for Traffic Safety [337]

Washington adjusted FARS data by analyzing only THC-positive drivers, not those positive for carboxy-THC. An average of 11.5% of drivers whose blood was tested for drugs between 2010 and 2013 had a THC concentration of 2 ng/mL or greater (range: 10.1% - 12.5%); that proportion increased to 17.1% in 2014.

Acute & Chronic Marijuana Use & Impairment:

Bondallza P, Favrat B, Chtioui H et al. Cannabis and its effects of driving skills. Forensic Sci Int'l 268 (2016) 92-102 [386]

Swiss literature review, incorporating results from the DRUID study. "Results presented in this review show a cannabis-induced impairment of actual driving performance by increasing ***lane weaving and mean distance headway to the preceding vehicle. Acute and long-term dose-dependent impairments of specific cognitive functions and psychomotor abilities were also noted, extending beyond a few weeks after the cessation of use.*** Although the correlation between blood or oral fluid concentrations and psychoactive effects of THC needs a better understanding, blood sampling has been shown to be the most effective way to evaluate the level of impairment of drivers under the influence of cannabis. ***The blood tests have also shown to be useful to highlight a chronic use of cannabis that suggests an addiction and therefore a long-term unfitness to drive.***

Oral Fluid Reliable Alternative to Blood:

Kelly-Baker T. Comparing Drug Detection in Oral Fluid and Blood: From a National Sample of Nighttime Drivers, *Traffic Injury Prevention*, 2013 [260]

"Oral fluid can be considered a reliable alternative to blood as a matrix for drug testing." Drug concentrations are typically higher in oral fluid than in blood.

Logan B. Detection and Prevalence of Drug Use in Arrested Drivers Using the Drager DrugTest 5000 and Affinition DrugWipe Oral Fluid Drug Screening Devices, *J of Analytical Toxicology*, 2014; 1-7 [211]

Tested 91 suspects arrested for DUI in Miami, FL using two roadside oral fluid testing devices and confirmed by oral fluid and urine laboratory confirmation. Sensitivity, specificity and accuracy were determined for both devices for all drugs tested. The most frequently detected drugs were cannabinoids (30%), benzodiazepines (11%), and cocaine (10%). Of drivers with BAC>.08, 39% were also drug positive. Both devices performed comparably, but the Drager device was more sensitive in detecting THC. The devices were less effective detecting benzodiazepines. Sensitivities were adequate (50-60%), with very high specificity (>96%).

Gjerde H, Clausen GB, Andreassen E et al. Evaluation of Drager Drug Test 5000 in a Naturalistic Setting. J Anal Tox 2018; 1-7 [436]

Results of Norwegian use of DT5000 since 2015. In cases with false-positive DDT5000 results compared to blood, traces of drugs were most often found in oral fluid. The DDT5000 did not absolutely correctly identify DUID offenders due to fairly large proportions of false-positive or false-negative results compared to drug concentrations in blood. ***The police reported that DDT5000 was still a valuable tool in identifying possible DUID offenders, resulting in more than doubling the number of apprehended DUID offenders.***

Oral Fluid Screening Valuable Tool Identifying Drug Use – Canada:

Beirness DJ, Smith DR. An assessment of oral fluid drug screening devices. Canadian

Society of Forensic Science Journal 2016 [364]

The Alere DDS 2R, Drager DrugTest 5000R and Securetec DrugWipe 6SR devices were evaluated. Sensitivity exceeded 0.80 for cannabis, cocaine, methamphetamine, and opioids. False positive rates for these drugs/drug categories were all between 3% and 7%. Specificity exceeded 0.90 for all drugs/drug categories. ***These findings indicate that oral fluid screening could prove to be a valuable tool in the detection of driver drug use in Canada.***

A Clear Distinction between two types of Oral Fluid Testing – Hydroxy THC:

1. Preliminary non-quantitative tests done at the roadside These use commercially available devices from companies such as Abbott/Alere, Drager, and SecureTec/DrugWipe. The devices screen for typically 6-8 classes of drugs and provide a positive/negative screening result in 10 minutes or less. The top devices test for most common drugs: ***THC (they can discriminate between THC and inactive carboxy-THC), opioids, cocaine, methamphetamine, and benzodiazepines.***
2. Evidentiary tests: Oral fluid can be collected with a number of commercially available sampling devices. The oral fluid is then transferred to a forensic toxicology laboratory that ***can test for drug presence and concentration, just as if it were a blood sample. Preliminary drug tests can perform the same function for drug assessment that PBTs (Preliminary Breath Tests) do for alcohol assessments.*** They can guide the officer in collecting appropriate evidence for a trial. The results may not admissible at trial. **However one court in California has permitted the results from a Drager device to be admitted into evidence.**

Oral Fluid Does Not:

It is important to understand that oral fluid devices neither attempt to nor claim to do any of the following:

1. Test for all drugs.

2. Prove "Impairment:" PBTs also don't prove alcohol impairment. Evidentiary blood tests don't prove impairment either, but they can prove violation of a DUI *per se* statute.

Impairment is proven by observations & evidence collected at the scene of an incident. ***Chemical tests, whether they be roadside or evidentiary laboratory tests either indicate or prove the chemical cause of the impairment that is otherwise observed and documented by police at the scene of an incident.***

3. Correspond to blood test results: Drug levels are different in different body fluids and tissues. The difference in concentration of a drug between blood and oral fluids varies by drug. For example, ***THC levels are higher in oral fluid than in the brain, higher in the brain than in blood, and higher in blood than in urine.*** One cannot expect an oral fluid result to correspond to a blood test, just as a blood test does not correspond to ***what really matters, which is the level in the brain.***

- **THC tests are specific for delta 9-THC with limited cross-reactivity to carboxy-THC.**

Under 21 Years of Age:

Increase penalty for traffic infraction for any person under twenty-one years of age to drive a motor vehicle or vehicle when the person has **any detectable level of impairing drugs** in their blood, breath or oral fluid at the time of driving or within two hours after driving.

Mandatory evidentiary drug testing:

• Evidentiary drug testing shall be performed on the blood or oral fluid of any driver who tests positive for drugs on a preliminary roadside screening test.

• Evidentiary drug testing shall be performed on the blood or oral fluid of all drivers involved in any crash which results in either death, serious bodily injury, or both.

Implement oral fluid testing:

- Roadside non-quantitative preliminary oral fluid testing devices may be used by officers if the officer has reasonable grounds to believe that the driver may be impaired by drugs. This shall parallel the similar provisions for preliminary breath testing.
- Results of non-quantitative oral fluid testing shall guide officers in evidence collection.
- Roadside non-quantitative oral fluid testing results shall not be admissible in trial.
- Evidentiary laboratory oral fluid testing may be used in lieu of blood evidentiary testing to prove the presence of an impairing substance.

In the absence of a scientifically based cannabis per se law, there are several options:

One is to train officers to detect the signs and symptoms of cannabis use in drivers stopped at roadside. Initial suspicion of cannabis use would lead to a field sobriety test (SFST). This process could be coupled with rapid, on-site oral fluid screening for evidence of drug use. The technology to detect certain drugs (including cannabis) in a specimen of oral fluid quickly at roadside is improving and could be used in a manner comparable to preliminary breath testing devices currently used to test for alcohol. The suspect would then be taken for a complete drug evaluation by a DRE. This approach requires enhancing the complement of DRE officers available to conduct assessments for impairment.

Although the terms are frequently used interchangeably, they are not identical. Saliva is the ultra-filtrate of plasma produced by the salivary glands. Oral fluid is predominantly saliva but also contains contaminants in the mouth left from eating, drinking, smoking and breathing. An oral swab is a common device used to obtain oral fluid for testing. All oral fluid tests do not rely upon swabs. The swab is not tested; the oral fluid obtained by the swab is tested.

Police Chief Magazine:

The Police Chief issued a succinct recommendation on the use of oral fluids last year in an article co-authored by a DRE, a prosecutor and a toxicologist, all highly respected in their fields of expertise:

"On-site oral fluid testing devices are not perfect; however, they provide a viable and cost-effective way to identify drugged drivers proximate to the traffic stop.

The authors recommend that officers screen all impaired drivers for drugs using on-site devices.

It is also recommended that jurisdictions consider replacing blood and urine testing with oral fluid laboratory tests for four reasons:

First, as noted above, McNeely and Birchfield make it difficult for officers to obtain blood (and possibly urine) samples without a warrant. However, those same cases suggest that oral fluid testing doesn't carry those legal challenges.

Second, officers can collect evidentiary samples for submission to the laboratory at roadside, which minimizes the possibility that the DUI subjects will eliminate the drugs from their system.

Third, positive oral fluid test results of a parent drug indicate recent usage only, potentially correlating to the duration of drug effect, and do not indicate use from days ago.

Fourth, it appears that states may criminalize oral fluid test refusals, unlike blood tests, thus increasing test compliance rates."

US Traffic Fatalities, 1985–2014, and Their Relationship to Medical Marijuana Laws

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Objectives. To determine the association of medical marijuana laws (MMLs) with traffic fatality rates.

Methods. Using data from the 1985–2014 Fatality Analysis Reporting System, we examined the association between MMLs and traffic fatalities in multilevel regression models while controlling for contemporaneous secular trends. We examined this association separately for each state enacting MMLs. We also evaluated the association between marijuana dispensaries and traffic fatalities.

Results. On average, MML states had lower traffic fatality rates than non-MML states. Medical marijuana laws were associated with immediate reductions in traffic fatalities in those aged 15 to 24 and 25 to 44 years, and with additional yearly gradual reductions in those aged 25 to 44 years. However, state-specific results showed that only 7 states experienced post-MML reductions. Dispensaries were also associated with traffic fatality reductions in those aged 25 to 44 years.

Conclusions. Both MMLs and dispensaries were associated with reductions in traffic fatalities, especially among those aged 25 to 44 years. State-specific analysis showed heterogeneity of the MML–traffic fatalities association, suggesting moderation by other local factors. These findings could influence policy decisions on the enactment or repealing of MMLs and how they are implemented. (*Am J Public Health.* 2017;107:336–342. doi:10.2105/AJPH.2016.303577)

In the past 2 decades, 23 US states and the District of Columbia have enacted laws allowing the use of cannabis (marijuana) to treat certain medical conditions.[1] Despite potential benefits of legislation protecting the medical use of marijuana, concern is increasing that medical marijuana laws (MMLs) may increase nonmedical marijuana use and the number of individuals driving under the influence of marijuana, and thus increase the rate of traffic injuries.[2]

Some simulator and on-road experimental studies show a dose-dependent association between marijuana exposure and several indicators of driving impairment.[3] Studies show that marijuana exposure is associated with increased response time and lane weaving.[4,5] In addition, it has been associated with impairment in other complex tasks requiring neurocognitive and neuromotor skills[6,7] that are likely to be involved in driving safely. Marijuana exposure has also been associated with reduced speed and greater headway,[4,8] which indicates some degree of awareness of marijuana-related impairment and a tendency to compensate.[8]

Despite these observations, population-based data have not shown an increase in traffic fatalities following medical marijuana legalization. A study that used 1990–2010 Fatality Analysis Reporting System (FARS) data showed that, contrary to expectations, MML enactment was associated with a reduction in the rates of traffic fatalities in the overall population (10.4% reduction), mainly because of a reduction in alcohol-related traffic fatalities.[9] These findings suggest that MML enactment could have contributed to an increase in marijuana use and lowered the use of alcohol, consistent with the substitution hypothesis,[10] in these states, partially explaining the reduced alcohol-related incidents observed.

Previous research[11] also shows that MMLs are heterogeneous across states, and that certain aspects of these laws, such as allowances on home cultivation or dispensaries, might be important to take into account when one is assessing the association between MMLs and different health outcomes. For example, a previous study showed that authorization of dispensaries in MML states was associated with treatment admissions in which marijuana is the primary substance of abuse.[11] One study to date has found evidence of dispensary legal provisions in MML states to be associated with an increase in traffic fatalities,[12] but the study did not examine the association between the actual presence of operational dispensaries (i.e., having an operating dispensary system even if not officially sanctioned) and traffic fatalities. Examining the role of operational dispensaries would provide additional information on whether increases in marijuana availability via dispensaries lead to changes in fatality rates.

We investigated the association between MML enactment and change in traffic fatalities, making use of a wider range of the FARS data, years 1985 to 2014, and including 9 additional states enacting MMLs between 2010 and 2014. We examined whether the

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rate of traffic fatalities changed following MML enactment in 1985 to 2014, if the magnitude of the association differed by state, and if estimates were robust to different model specifications and to the inclusion of potential confounders in the model. In addition, we explored the specific role of operational medical marijuana dispensaries on traffic fatality rates.

METHODS

Data came from the FARS, a nationwide census of traffic fatalities information maintained by the National Highway Traffic Safety Administration. Briefly, this data set provides data on individuals fatally injured in motor vehicle crashes on public roads in the United States who died within 30 days of the crash.[13] Data include driver characteristics such as age, gender, and race. We obtained the aggregated FARS data from different sources including police accident reports, death certificates, coroner or medical examiner reports, hospital medical reports, state highway department data, emergency medical services records, vital statistics, and other state records.[13] Trained analysts collected the data by using standardized protocols that automatically check for acceptable range values and consistency.[13] We used FARS data from years 1985 to 2014, enabling us to include at least 10 years of pre-MML data for all states enacting these laws. We did not include the District of Columbia in the analyses.

Measures

Traffic fatalities. Our outcome of interest was the rate of traffic fatalities across time. We obtained the total number of fatally injured road users, including drivers, passengers, cyclists, and pedestrians, by year, state, and age group (entire population, and those aged 15–24, 25–44, and ≥ 45 years) from FARS. We obtained state populations for each year, state, and age group used to calculate fatality rates for each state from the Web-based Injury Statistics Query and Reporting System of the Centers for Disease Control and Prevention.[14] In analyses for the entire population, we used age-adjusted traffic fatality rates based on the 2000 US population.

Enactment and effective date of medical marijuana laws. Our main exposure was the enactment of MMLs by state, as defined by legal scholars, economists, and policy analysts at RAND Corporation[15] (Table A, available as a supplement to the online version of this article at http://www.ajph.org). First, we coded the MML variable as a time-varying (i.e., allowed to change over time), 3-category variable. The 3 categories were before, after, and never. States enacting medical marijuana laws were coded as "before" for the years before the enactment of the laws, and as "after" for years after. For example, because Vermont enacted its MML in 2004, this state is coded as "before" for years 1985 to 2003 and as "after" for years 2004 to 2014. As MMLs are enacted in different months, if the law was enacted between January 1 and June 30, we coded the year of MML enactment as "after," because the state was exposed to the MML for at least half of the year in which it was enacted. Alternatively, if the MML was enacted between July 1 and December 31, we coded the year of MML enactment as "before," because the state was exposed to the MML only for the second half of the year. States without MMLs up to 2014 were coded as "never" for all years.

We also used the date when MMLs became effective, when the statutory obligation commences in each state, rather than the date enacted. We used the same coding strategy as the one used for enactment dates.

Operational dispensaries. We coded the presence of operational dispensaries in MML states as a time-varying, 3-category variable in a similar way as we did for our MML variable—before, after, and never—on the basis of previous[11,16] and recent information provided by researchers at RAND Corporation. States with MMLs were coded as "before" for years before they had operational dispensaries, and were coded as "after" for years when the state had legally operating dispensaries. This is when legislation was passed allowing marijuana sales and also an operational regulatory and distribution regime,[16] or if the state had a functional dispensary system, even if not officially sanctioned[16] (Table A). States without dispensaries were coded as "never" for all years.

Covariates. We adjusted our analyses for time-varying state characteristics and state legislation used in previous research.[9] State-level covariates included unemployment rate and median household income, speed limits of 70 miles per hour or greater,[17] primary seat belt laws enforcement, laws decriminalizing the possession of small amounts of marijuana, and whether states had enacted a recreational marijuana law.[18,19] The later 4 covariates were coded as "1" if the state had the law in any given year and "0" otherwise. We also controlled for state-level graduated driver license laws,[20] blood alcohol content laws (0.08 g/dL), drug per se laws,[21] administrative license revocation laws,[22] and laws banning cell phone use and texting while driving, separately targeting adolescents and adults.[23] These later 5 covariates were coded as "1" if the state had the law in any given year and "0" otherwise; also, if the enactment of the law occurred during a calendar year, we coded that year as the proportion of the year the law was in effect. In addition, we included a measure of state annual expenditures for highway law enforcement and safety per capita (adjusted to 2000 dollars), and also a state measure of the annual vehicle miles driven per licensed driver (thousands of miles) from Highway Statistics, US Department of Transportation (both covariates log transformed).

Because alcohol consumption can be a confounder of the association between MML and traffic fatalities, we also explored the robustness of estimates when we controlled for a measure of the state-level per capita ethanol sales, total ethanol of all beverages combined per population aged 21 years or older (log transformed) from the Surveillance Reports of the National Institute on Alcohol Abuse and Alcoholism. Results are presented in Table B, available as a supplement to the online version of this article at http://www.ajph.org. However, because changes in ethanol sales could be a mechanism through which MML influences traffic fatalities, all results provided, except when indicated, are from models not including this covariate.

Statistical Analyses

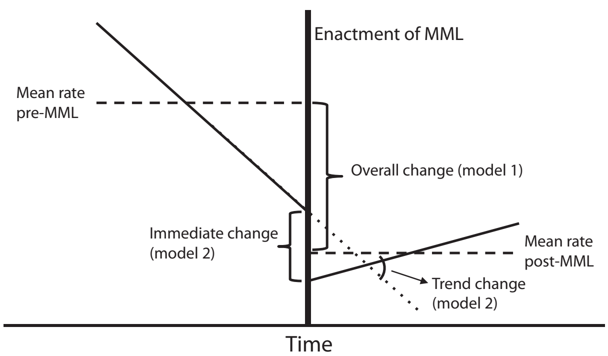
To examine whether MMLs were associated with changes in the natural logarithm of the rate of traffic fatalities, we used linear multilevel regression models[24] with state-level random intercepts. This main effect model, which used the 3-category MML as the exposure variable, allowed us to determine the change in the rate of fatalities within states before and after MML enactment (Figure 1: overall change, model 1) while taking into account the rates in states that did not enact MMLs. In addition, we used a piecewise cubic spline[25] with a knot at 2007 to control for the nonlinearity of national trends in traffic fatality rates; this allowed us to control for any national events that could have influenced traffic fatality rates across states over time. All models were stratified by age group, weighted by the state population, and adjusted for covariates. The percent change in fatality rates associated with the enactment of MMLs was estimated with the equation,

(1) % change = (1—exp[estimate difference between pre/post MML rates]) × 100%.

To estimate the yearly variation in the rates of traffic fatalities after the enactment of MMLs, we used an alternative model strategy by including linear trends for years before and after the enactment of MML for states with these laws.[26] In this "hybrid" model, the estimate for the 3-category MML variable represents the "immediate" change in the rate soon after MMLs are enacted, and the "trend" effect represents the change in the linear trend, from the pre-MML to the post-MML period[26] (Figure 1). The hybrid model can be useful to identify a change in the trend in cases such as the one presented in Figure 1, when a marked decreasing trend in traffic fatalities in the pre-MML period is followed by an immediate reduction and then by a gradual increasing trend in traffic fatalities in the post-MML period. In this scenario, the main effect model would show an overall reduction in traffic fatalities associated with MML despite the change in the trend. The pattern in Figure 1 could emerge if, for example, the enactment of MML is followed by stronger police enforcement soon after the enactment that would result in an immediate reduction in traffic fatality rates; however, a possible gradual increase in the prevalence of marijuana use after enactment of MMLs could result in a gradually increasing prevalence of driving while intoxicated, leading to a gradual increase in traffic fatalities.

We also examined the association between operational dispensaries and traffic fatalities by using similar models as described previously adjusted by covariates and also by the time-variant MML variable indicating whether states had or had not enacted MMLs.

Finally, we examined the state-specific association between MMLs and traffic fatalities in the entire population (i.e., all ages) by including state as a fixed effect in models, both in the main effect and hybrid models, with interaction terms (1) between MML and states, and (2) between pre–post-MML trends and states; in this model we dichotomized the MML variable as "1" in years in which states had a MML, and "0" otherwise. This provided us the before–after comparison and the change in trends separately for each state that passed MMLs. We performed statistical analysis with SAS version 9.4 (SAS Institute Inc, Cary, NC).



Note. MML = medical marijuana law.

FIGURE 1—Model Estimates With a Main Effect Model Strategy (Model 1) and With a Hybrid Model Including Immediate and Trend Effects (Model 2) to Examine the Association Between Medical Marijuana Laws and Traffic Fatalities, United States, 1985–2014

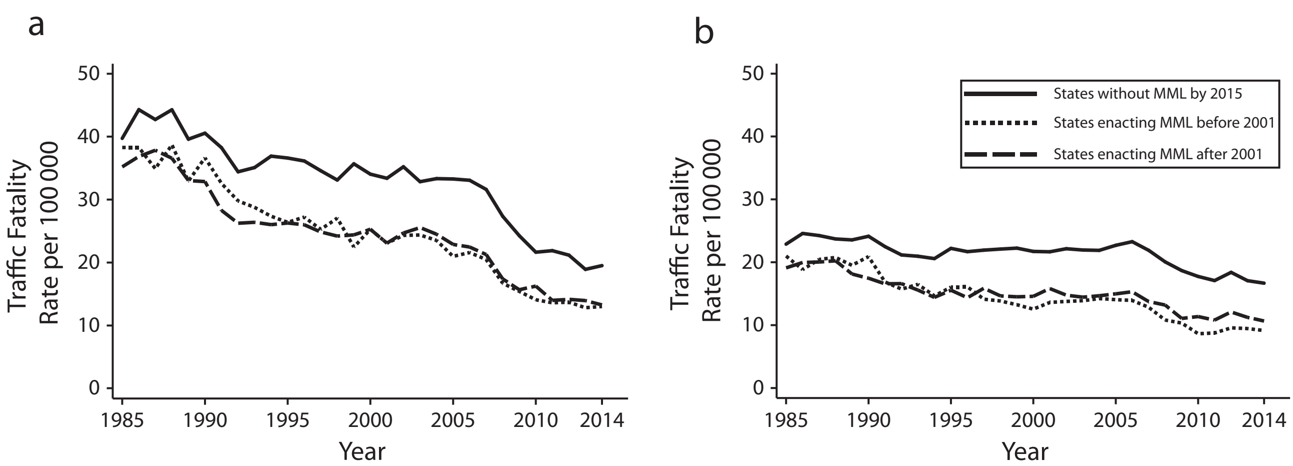
RESULTS

A total of 1 220 610 deaths attributable to traffic crashes occurred in the 50 states during the study period (1985–2014). We observed a reduction in the age-adjusted (2000 US population) national rate of traffic fatalities from 1985 (17.8 per 100 000) to 2014 (10.0 per 100 000). Although, on average, states enacting MMLs had lower rates of traffic fatalities compared with states without MMLs (26.3% lower; 95% confidence interval [CI] = 13.9%, 36.9%) states with and without MMLs followed a similar trend pattern toward reductions in traffic fatality rates (Figure 2). Among individuals aged 24 to 44 years, the trend for states enacting MMLs before 2001 slightly deviated during 1996 to 2000, the period in which these states enacted their MMLs, from that of states enacting MMLs after 2001.

Medical Marijuana Law Enactment and Traffic Fatality Rates

Results from main effect models for the entire population (i.e., all ages) showed that, among states passing MMLs, the mean traffic fatality rate in the pre-MML period (12.1 per 100 000) was significantly higher than that in the post-MML period (11.2 per 100 000), indicating a reduction of 10.8% (95% CI = 9.0%, 12.5%; % reduction = [1 − exp(−0.114)] × 100) in traffic fatality rates (Table 1). Similarly, we observed a reduction of 11.0% (95% CI = 8.5%, 13.5%), 12.0% (95% CI = 9.5%, 14.3%), and 9.0% (95% CI = 6.9%, 11.0%) among those aged 15 to 24 years, 25 to 44 years, and 45 years and older, respectively (Table 1).

In hybrid models for the entire population, the immediate effect (i.e., sudden change in fatality rate after MML enactment), indicated that there was an immediate reduction of 3.5% (95% CI = 1.1%, 5.8%), whereas the gradual effect (i.e., change in rate trend after MML enactment) was not significant (Table 1). For those aged 15 to 24 and 25 to 44 years, there were also similar immediate reductions in traffic fatalities as those observed in the entire population. Among those aged 25 to 44 years, the gradual effect was also negative and significant (difference in pre–post MML trends = −0.005; $P < .01$). We observed no significant reductions among those aged 45 years or older in hybrid models (Table 1).



Note. MML = medical marijuana law. Linear trends (estimate and *P* value). Group aged 15–24 years: states without MMLs by 2015 (–0.75; $P < .001$); states enacting MMLs before 2001 (–0.88; $P < .001$); and states enacting MMLs after 2001 (–0.76; $P < .001$). Group aged 25–44 years: states without MMLs by 2015 (–0.20; $P < .001$); states enacting MMLs before 2001 (–0.40; $P < .001$); and states enacting MMLs after 2001 (–0.28; $P < .001$). Figures for all age groups are provided in Figure A, available as a supplement to the online version of this article at http://www.ajph.org.

FIGURE 2—Traffic Fatality Rates Across States Enacting Medical Marijuana Laws and Those Without Medical Marijuana Laws by 2014 Among Those Aged (a) 15–24 Years and (b) 25–44 Years: United States, 1985–2014

Operational Dispensaries and Traffic Fatality Rates

Results from main effect models showed that dispensaries were associated with a significant reduction in traffic fatalities in those aged 25 to 44 years (5.1%; 95% CI = 1.5%, 8.6%), and a nonsignificant reduction in the entire population (2.7%; 95% CI = –0.01%, 5.3%; Table 1). In hybrid models, the immediate effect and gradual effects were not significant for any of the age groups (Table 1).

In the main effect models, further control for the state-level per-capita ethanol sales (log transformed) covariate reduced the magnitude of the association between MMLs and traffic fatalities by 20% to 22% across age groups, although estimates remained significant at a 95% confidence level (Table B). Hybrid models were not impacted by the inclusion of this ethanol sales covariate.

Results for the association between "MML effective date" variable and traffic fatality rates were almost identical to those described previously for the "MML enactment date" variable (Table C, available as a supplement to the online version of this article at http://www.ajph.org).

Estimates for Individual States

Results from the main effect model show that in 7 states (California, Oregon, Washington, Colorado, Nevada, New Mexico, and Arizona) the MML enactment was significantly associated with a reduction in traffic fatality rates, whereas in 2 states (Rhode Island and Connecticut) MMLs were associated with an increase in rates (Table 2).

In hybrid models, only 4 states showed significant associations: California showed an immediate post-MML reduction of 16.0% in traffic fatalities (95% CI = 12.0%, 20.0%) followed by a gradual yearly increase (difference in pre–post-MML trends = 0.013; $P < .01$); similarly, New Mexico had an immediate post-MML reduction of 17.5% (95% CI = 1.4%, 31.0%) and significant post-MML gradual increase in traffic fatalities (difference in pre–post-MML trends = 0.049; $P < .01$); Colorado had a nonsignificant immediate increase and a yearly significant reduction in fatality rates (difference in pre–post-MML trends = –0.022; $P < .05$); and Michigan had a positive immediate increase of 14.2% in traffic fatalities (95% CI = 4.7%, 24.5%) and a nonsignificant trend effect (Table 2).

DISCUSSION

Using population-based data from 1985 to 2014, we found that, first, states that enacted MMLs during the study period had lower fatality rates compared with states without MMLs. Second, on average, traffic fatalities further decreased in states post-MML, with both immediate (sudden change in fatality rate after MML enactment) and gradual (change in rate trend after MML enactment) declines over time in those aged 25 to 44 years. Third, the association between MML and traffic fatalities varied considerably across states. Fourth, the presence of operational dispensaries was also associated with reductions in traffic fatalities in those aged 25 to 44 years.

We found that, on average during the study period, MML states had lower traffic fatality rates than non-MML states. It is possible that this is related to lower levels of alcohol-impaired driving behavior in MML states. Evidence from the Behavioral Risk Factor Surveillance Systems data from 2000[27] and 2012[28] shows that states that have enacted MMLs, compared with non-MML states, had, on average, lower proportions or rates of drivers endorsing having driven after having too much to drink. In addition, other unmeasured characteristics, including strength of public health laws related to driving, infrastructure characteristics (e.g., high-technology roads), or quality of health care systems, may partially explain these findings.

TABLE 1—Estimate of the Association Between the Enactment of State Medical Marijuana Laws, Operational Dispensaries, and States' Traffic Fatality Rates (Natural Logarithm) by Age Group: United States, 1985–2014

	Rate Difference[a] (95% CI)			
Effect	Age 15–24 Years	Age 25–44 Years	Age ≥45 Years	All Ages
Medical marijuana laws				
Main effect	−0.117 (−0.145, −0.089)	−0.127 (−0.155, −0.100)	−0.095 (−0.117, −0.072)	−0.114 (−0.134, −0.094)
Hybrid model				
Immediate effect	−0.059 (−0.095, −0.023)	−0.040 (−0.075, −0.006)	−0.020 (−0.048, 0.008)	−0.036 (−0.060, −0.011)
Trend effect	0.002 (−0.002, 0.005)	−0.005 (−0.009, −0.002)	−0.0001 (−0.003, 0.003)	−0.001 (−0.004, 0.001)
Operational dispensaries				
Main effect	−0.006 (−0.045, 0.033)	−0.053 (−0.090, −0.015)	−0.024 (−0.055, 0.007)	−0.027 (−0.055, 0.0001)
Hybrid model				
Immediate effect	0.008 (−0.038, 0.055)	−0.002 (−0.047, 0.043)	0.016 (−0.019, 0.052)	0.014 (−0.017, 0.046)
Trend effect	0.007 (−0.0004, 0.014)	−0.005 (−0.012, 0.017)	−0.0001 (−0.006, 0.006)	−0.001 (−0.006, 0.004)

Note. CI = confidence interval; MML = medical marijuana law. All models are adjusted by the national trend of vehicle miles driven per licensed driver and the following state-level covariates: population size, unemployment rate, median household income, speed limits of 70 mph or greater, primary seat belt enforcement laws, graduated driver license laws, blood alcohol content laws, drug per se laws, administrative license revocation laws, highway law enforcement and safety expenditures, decriminalization of marijuana laws, recreational marijuana laws, bans on texting and cell phone use while driving laws targeting adolescents and adults, and annual miles driven per licensed driver. All models were multilevel random intercept regression models with random intercepts for states and a cubic form of time with a piecewise linear spline with a knot at 2007.

[a]Log scale.

Our study also shows that, on average, MMLs were associated with an overall reduction in traffic fatalities in main effect models. In addition, in hybrid models, we found immediate and gradual reductions only among those aged 25 to 44 years, a group representing a great percentage of all registered patients for medical marijuana use,[29] and a group showing increases in the prevalence of marijuana use in association with the enactment of MMLs.[30] Interestingly, we did not find strong evidence suggesting reductions among those aged 45 years and older, which is also a group overrepresented in the population of patients registered in state medical marijuana programs.[29] This suggests that the mechanisms by which MMLs reduce traffic fatalities mostly operate in those younger adults, a group also frequently involved in alcohol-related traffic fatalities; in 2004 and 2013, 47% of fatally injured drivers with a blood alcohol content of 0.08 or greater were aged 25 to 44 years.[31]

There may be different mechanisms by which MMLs may reduce traffic fatalities. Some evidence suggests[9] that MMLs may increase marijuana use in the population and, consistent with the substitution hypothesis,[10] reduce the prevalence of alcohol consumption that, in turn, would result in lower rates of alcohol-related traffic fatalities. Anderson et al.[9] found reductions in traffic fatalities in which at least 1 driver was positive for any alcohol in the blood (marginally, $P<.1$) and those with blood alcohol concentrations greater than or equal to 0.1 grams per deciliter ($P<.05$), and also reductions in traffic fatality rates occurring on weekends, which are more likely to be alcohol-related than those on weekdays.

If MMLs reduce traffic fatalities by reducing alcohol-related deaths, it is expected that these reductions would have been gradual given that MMLs are likely to gradually increase the availability of marijuana as dispensaries are opened and the number of patients getting access to medical marijuana increases, for example, as described for patient registries across MML states.[29] However, immediate reductions may also occur if the enactment of MMLs produces rapid changes in attitudes toward marijuana use in the overall population, reducing perceptions of risk associated with marijuana use. In addition, immediate reductions can be the result of stronger preventive police enforcement actions targeting weekend drivers occurring soon after the enactment of MMLs. In this regard, because few registered patients for medical marijuana are aged 15 to 24 years[29] and also because MMLs had not been found to be associated with marijuana use in individuals aged 25 years or younger[30] nor in adolescents,[32,33] it is possible that the immediate reduction we observed in the hybrid model for those aged 15 to 24 years is related to external control measures, such as stronger police enforcement actions.

Our findings for specific state associations suggest that not all MML states experienced reductions in traffic fatality rates, but few actually experienced increases. Although results from main effects models suggest beneficial reductions in traffic fatalities for 7 states, in the hybrid model, only Colorado showed a significant yearly reduction in traffic fatalities. In California and New Mexico, after an initial immediate reduction, MMLs were actually associated with gradual increases in fatality rates. These findings provide evidence of the heterogeneity of MML–traffic fatalities associations across states and indicate the need for further research on the particularities of MML implementation at the local level and the interaction of MMLs with other aspects that may influence traffic fatality rates.

Finally, results from our operational dispensaries analyses, at least from the main effect model, support the initial findings that MMLs were associated with reductions in traffic fatalities among those aged 25 to 44 years and suggest that this may in part occur via increases in marijuana availability.

Limitations

Limitations are noted. First, we described an overall association between MMLs and traffic fatalities, but we are uncertain of what the causal chain may be. This study adds to

TABLE 2—Estimate of the Association Between the Enactment of State Medical Marijuana Laws and States' Rate of Traffic Fatalities (Natural Logarithm) by State: United States, 1985–2014

State	Rate of Traffic Fatalities		MML on Traffic Fatality Rates, Model 1, Main Effect (SE)	MML on Traffic Fatality Rates, Model 2, Hybrid Model	
	1985	2014		Immediate Effect (SE)	Trend Effect (SE)
California	17.95	7.72	−0.199** (0.014)	−0.175** (0.024)	0.013** (0.004)
Oregon	20.6	8.5	−0.226** (0.037)	−0.053 (0.067)	0.008 (0.008)
Washington	16.59	6.34	−0.217** (0.030)	−0.008 (0.054)	0.0002 (0.007)
Alaska	23.42	9.93	−0.116 (0.083)	0.168 (0.152)	−0.007 (0.018)
Maine	17.12	9.16	0.035 (0.058)	0.048 (0.106)	0.002 (0.012)
Colorado	17.57	8.95	−0.068* (0.032)	0.089 (0.059)	−0.022* (0.007)
Nevada	26.75	10.08	−0.198** (0.054)	0.003 (0.089)	0.008 (0.010)
Hawaii	11.6	6.55	0.040 (0.059)	0.019 (0.108)	−0.013 (0.013)
Maryland	15.74	7.34	0.001 (0.03)	0.028 (0.052)	−0.003 (0.007)
Montana	27.1	18.92	0.052 (0.071)	−0.020 (0.125)	−0.011 (0.019)
Vermont	20.91	6.44	−0.122 (0.086)	0.050 (0.153)	0.003 (0.022)
Rhode Island	10.4	4.44	0.179* (0.070)	0.111 (0.121)	0.011 (0.021)
New Mexico	36.24	18.58	−0.243** (0.053)	−0.193* (0.091)	0.049** (0.018)
Michigan	16.7	8.85	0.0001 (0.027)	0.132** (0.044)	0.021 (0.013)
New Jersey	12.29	5.99	0.023 (0.030)	0.077 (0.048)	−0.010 (0.017)
Arizona	27.47	11.17	−0.195** (0.039)	−0.029 (0.060)	−0.024 (0.028)
Delaware	15.92	12.59	0.103 (0.101)	−0.044 (0.159)	0.040 (0.075)
Connecticut	13.19	6.8	0.169** (0.062)	0.162 (0.088)	−0.024 (0.060)
Massachusetts	11.81	4.67	−0.020 (0.055)	0.034 (0.069)	0.027 (0.088)
Summary[a]					
Increase—significant			2	1	2
Reduction—significant			7	2	1
Increase—not significant			7	10	9
Reduction—not significant			3	6	7

Note. MML = medical marijuana law. Model 1: linear regression model with interaction term between MML and state, adjusted by a cubic form of time with a piecewise linear spline with a knot at 2007, and covariates. Model 2: linear regression model with interaction terms between MML and state, interaction terms between pre–post-MML trends and states, and adjusted by a cubic form of time with a piecewise linear spline with a knot at 2007, and covariates. All models are adjusted by the national trend of vehicle miles driven per licensed driver and the following state-level covariates: population size, unemployment rate, median household income, speed limits of 70 mph or greater, primary seat belt enforcement laws, graduated driver license laws, blood alcohol content laws, drug per se laws, administrative license revocation laws, highway law enforcement and safety expenditures, decriminalization of marijuana laws, recreational marijuana laws, bans on texting and cell phone use while driving laws targeting adolescents and adults, and annual miles driven per licensed driver.

[a]In the summary section, significance is based on $P < .05$.

*$P < .05$; **$P < .01$.

evidence of the association between MMLs and traffic fatalities, laying the groundwork for future studies on specific mechanisms. Moreover, our data suggest that one mechanism is through increases in marijuana availability as dispensaries become operational. Second, because we used state-level aggregate data, we could not observe whether associations vary across different cities or counties. However, our study provides state-level estimates, the level at which MMLs are enacted. Further research at local levels will improve our understanding of how MML aspects and also other factors relate to traffic fatalities.

Third, we did not examine other variations in medical marijuana laws (e.g., home cultivation, approved illnesses) in our models that could also have an effect on traffic fatalities. However, we examined the additional effect of operational dispensaries, an important factor increasing the availability of marijuana. Fourth, for states enacting MMLs after 2010, we had only short post-MML periods, which limited the identification of long-term effects in these states.

Fifth, we could not examine whether MMLs were associated with increments in the rates of traffic fatalities in which drivers tested positive for the presence of cannabis metabolites in blood. Testing procedures vary by state and our own exploration of FARS data showed that only a limited number of states tested 80% or more of their fatally injured drivers. In addition, the FARS coding system does not differentiate between active and inactive cannabinoid metabolites[34] and, therefore, it is not possible to know whether the driver was driving under the influence of marijuana. Sixth, we used data on traffic fatalities, the most extreme injury outcome; therefore, we cannot make any observations on the association between MMLs and nonfatal traffic injuries.

Finally, our measure of per-capita alcohol consumption may not fully capture varying alcohol consumption patterns in the population, and is not informative about specific age groups. However, per-capita alcohol consumption data have moderate to strong correlations with survey measures of drinking, heavy drinking, and binge drinking,[35] and this indicator of overall alcohol consumption in the United States has been a long-term National Institutes of Health indicator of time trends in drinking.

Implications

Our study suggests that, on average, MMLs are associated with reductions in traffic fatalities, particularly pronounced among those aged 25 to 44 years, a group representing a great percentage of all registered patients for medical marijuana use,[29] and with increased prevalence of marijuana use after the enactment of MMLs.[30] Although increases in marijuana use following the establishment of marijuana dispensaries could reduce the occurrence of alcohol-related mortality by reducing the number of drivers driving under the influence of alcohol, other simultaneous factors at the state and local levels also may be responsible for these changes in traffic fatalities. Our findings show great heterogeneity of the MML–traffic fatalities associations across states, suggesting the presence of these other mechanisms. This is important for policy development and for the debate of the enactment or repealing of MMLs, given that alternative local strategies such as stronger police enforcement and programs aiming to reduce impaired driving involving any substance use could be local factors linked to reductions in traffic fatalities in MML states. AJPH

CONTRIBUTORS

J. Santaella-Tenorio developed the design and conceptualization of the study, collected and analyzed the data under supervision of M. M. Wall and C. M. Mauro, interpreted the results, and wrote the original draft of the article. J. H. Kim, C. M. Mauro, and S. S. Martins contributed to the design and conceptualization of the study and to the interpretation of results and helped draft the article. M. M. Wall, M. Cerdá, K. M. Keyes, D. S. Hasin, and S. Galea contributed to the interpretation of results and helped draft the article.

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HUMAN PARTICIPANT PROTECTION

Ethics approval was not needed for this work because it used publically available, de-identified data.

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Validation of the Standardized Field Sobriety Test Battery at 0.08% Blood Alcohol Concentration

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Objective: A field study was conducted to evaluate the accuracy of the Standardized Field Sobriety Test (SFST) battery to assist officers in making arrest decisions at blood alcohol concentrations (BACs) below 0.10%. **Background:** The SFST Battery was validated at 0.10% BAC in 1981, but since then many states have reduced statutory limits for driving while intoxicated to 0.08% BAC. **Methods:** During routine patrols, participating officers followed study procedures in administering SFSTs, scoring results, making arrest/no arrest decisions, and completing a data collection form for each of the 297 motorists evaluated during the study period. The officers' final step in each case was the administration of an evidentiary breath alcohol test. **Results:** Overall, officers' decisions were correct in more than 91% of the cases at the 0.08% BAC level. Cohen's kappa tests found all officers' scores to be within the categories of "substantial" and "near perfect" agreement, indicating low variance among the officers and a high degree of interrater reliability. **Conclusion:** The results of this study provide evidence of the validity of the SFST Battery as an accurate and reliable decision aid for discriminating between BACs above and below 0.08%. **Application:** The SFST Battery presently is used by law enforcement officers throughout the United States to help make roadside arrest decisions for impaired driving.

INTRODUCTION

The Standardized Field Sobriety Test (SFST) battery was developed to assist law enforcement officers in making roadside arrest decisions for alcohol-impaired driving at the 0.10% blood alcohol concentration (BAC) limit (Burns & Moskowitz, 1977; Tharp, Burns, & Moskowitz, 1981). The gradual adoption of 0.08% BAC as the statutory criterion for driving while impaired (DWI) offenses prompted an assessment of the SFST's utility to assist officers when making arrest decisions at BACs below 0.10%. The results of that assessment are presented here.

The SFST Battery

The three components of the SFST battery are described in the following paragraphs.

Horizontal gaze nystagmus test. Horizontal gaze nystagmus (HGN) is an involuntary jerking of the eye that occurs naturally as the eyes gaze to the side. Under normal circumstances, nystagmus occurs when the eyes are rotated at high peripheral angles. However, nystagmus is exaggerated and may occur at lesser angles when a person is impaired by alcohol. An alcohol-impaired person also will have difficulty tracking a moving object smoothly (Aschan, 1958; Lehti, 1976; Pentilla, Tenhu, & Kataja, 1974; Wilkinson, Kime, & Purnell, 1974). In the HGN test, the officer observes the eyes of a suspect as the suspect follows a slowly moving object, such as a pen or small flashlight, horizontally with his or her eyes. The officer looks for three indicators of impairment in each eye: The eye cannot follow a moving object smoothly, jerking is distinct when the eye is at maximum deviation, and the angle of onset of jerking is within 45° of center. HGN also may indicate a rare and usually debilitating neurological condition or consumption of seizure medications, phencyclidine, certain inhalants, barbiturates, and other central nervous system depressants.

Walk and turn. The walk-and-turn and one-leg stand components of the SFST battery require

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performance of physical tasks but are essentially "divided attention" tests. The tests require the person to listen to and follow instructions while performing simple physical movements. People who are impaired by alcohol have difficulty with tasks that require their attention to be divided between simple mental and physical exercises. In the walk-and-turn test, the motorist is directed to take nine steps, heel to toe, along a straight line. After taking the steps, the motorist must turn on one foot and return in the same manner in the opposite direction. The officer looks for eight indicators of impairment: The person cannot keep balance while listening to the instructions, begins before the instructions are finished, stops while walking to regain balance, does not touch the heel to the toe, steps off the line, uses arms to balance, makes an improper turn, or takes an incorrect number of steps.

One-leg stand. This test requires the motorist to stand with one foot approximately 6 inches (about 15 cm) off the ground while counting aloud by thousands (one thousand one, one thousand two, etc.) until instructed to lower the foot after 30 s. The officer looks for four indicators of impairment: swaying while balancing, using arms to balance, hopping to maintain balance, and putting the foot down before instructed to do so.

METHOD

Field experience with the SFST battery at 0.10% BAC led to the hypothesis that modified scoring of test results could provide officers with the information necessary to make accurate roadside arrest decisions at lower BACs. The hypothesized changes to the procedures were simple: The exhibition of two or more clues on the one-leg stand or walk-and-turn tests would indicate a BAC of at least 0.08%, rather than 0.10%, which had been established by the original studies. Similarly, the exhibition of four HGN clues would indicate a BAC of 0.08% or greater, rather than 0.10%. (Note: The eyes are scored separately with a total of six clues possible.) The only other deviation from the existing procedures would be to use the exhibition of two HGN clues as an indication of BACs greater than zero but below 0.08%.

Site Selection

Several factors constrained the site selection process and limited the possible candidates for participation in this study. First, at the time the project was conducted, California, Oregon, and Utah were the only states that met both of the BAC-related site selection criteria – namely, a 0.08% BAC limit for DWI and a zero-tolerance law for drivers under 21 years of age. Second, it was important to restrict the data collection period, to the extent possible, because it was believed that an extremely long period might result in officers deviating from the study procedures. Strict adherence to study procedures was considered essential to ensuring the internal validity of the study.

All participating officers in the 1981 study were trained by the researchers to administer and score the experimental test battery. However, more than 300,000 officers have received SFST training since 1981. For this reason, it was determined that only officers who had previously received SFST training from a certified instructor could participate in the current study, whereas in 1981 novice officers were trained. The purposes of the stipulation were to ensure that experimental conditions accurately reflected the operational condition of widespread use of the SFSTs by law enforcement officers and to avoid confounding study results with the effects of differential officer skill and experience levels in SFST administration and scoring. The city of San Diego, California, was identified as the community that best satisfied the site selection criteria.

Dependent Measures

The experiment plan focused on obtaining data about adult motorists who were suspected of exceeding the statutory limit of 0.08% BAC and drivers under 21 who were suspected of exceeding the zero-tolerance legal limit of 0.00%. The utility of the SFSTs to discriminate at 0.08% and 0.04% BAC could not be tested without data from drivers who had BACs over and under these values. BACs and officers' arrest decisions are the only appropriate criteria for evaluating the accuracy of the SFSTs. Measures of impairment are irrelevant because performance of the SFSTs must be correlated with BAC level, not with driving performance. BAC provides an objective and reliable measure that states have recognized as presumptive and/or per se evidence of impairment, depending on the statute. To obtain these criterion measures, it was determined that all drivers who were administered the SFST battery must be tested for BAC, regardless of the results of the SFSTs or the officers' arrest decisions.

Procedures

The requirement for an agency to modify its established methods of operation to accommodate research requirements usually is somewhat negotiable in a traffic safety study. However, deviations from study procedures were not allowed in this case. All participating officers were required to abide by the established procedures. In particular, no tests other than the SFSTs could be administered to drivers, and officers were required to perform the tasks in the prescribed sequence.

The procedures were listed as a series of six numbered steps on the data collection forms used in the field study. Officers were instructed to perform their normal patrol duties and to follow the procedures whenever an adult driver was suspected of being alcohol impaired or a driver under 21 was suspected of having a BAC greater than zero. In practice, officers administered the SFSTs to all motorists who exhibited any objective behavior or other driving cue associated with the effects of alcohol, even if impairment was not evident. A breath, blood, or urine test was administered to all motorists who performed the SFSTs, but only after the officer had scored and recorded the SFST test results, BAC estimate, and arrest/no arrest decision on the form. The data collection form structured the procedure by presenting all officer actions as a series of numbered steps. Requiring officers to record the times of BAC estimates and BAC tests on the form provided verification that officers' estimates were not influenced by the results of chemical tests performed later. The 7 participating officers received 4 hr of training in the administration of study procedures, and their performance was verified by a certified SFST instructor. Also, the officers and police managers signed memoranda of agreement affirming that they would abide by the established procedures during the study period. In addition, project staff periodically accompanied officers on patrol to observe the data collection effort.

Legal Issues

In some states, including California, officers have the right to administer a breath test to a driver who has exhibited any objective sign of alcohol consumption. Compliance is mandatory if the officer can articulate a reasonable suspicion of the motorist having consumed alcohol (such as the odor of an alcoholic beverage). SFSTs were administered only to drivers who exhibited some objective DWI cue; thus there were no legal or methodological obstacles to obtaining BAC data, even from motorists whose SFST performance was acceptable. A field breath test was conducted as the final step after the SFST procedure was completed, which is the de facto procedure followed by most officers who are equipped with field breath testing devices.

Materials

A pen, pencil, or small flashlight usually is used by officers as a stimulus or target for the HGN test, but a finger is equally effective; that is, no special equipment was required to administer the three components of the SFST battery. However, officers were equipped with evidentiary-quality, handheld breath testing devices with digital displays to obtain breath test data.

The data collection form was designed to be as simple to complete as possible in order to minimize the intrusion of study requirements on the workload and safety of participating officers. The form also was designed to guide the officers in the administration of the SFSTs, to facilitate standardized and systematic scoring of the tests, and to both encourage and provide assurances that officers had followed the study procedures. Most important, it was essential that officers would conduct a breath test and record the driver's BAC as the final steps of the process; that is, actual BACs were to be entered on the form, and the time of the breath test recorded, only after SFST results, the officer's BAC estimate, and the arrest/no arrest decision had been recorded.

RESULTS

The 7 participating officers from the San Diego Police Department's alcohol enforcement unit completed a total of 298 data collection forms during the study period; 1 case was eliminated from analysis because the driver refused to submit to any form of BAC testing. Officer compliance with study procedures and motivation to participate in the study remained high throughout the data collection period. The officers' practice of administering the SFSTs to all motorists who exhibited any behavior associated with the effects of alcohol, even if impairment was not evident, provided additional low-BAC drivers to the sample.

Evaluation of SFST Accuracy

Decision matrices were constructed to describe the four possible combinations of the two variables of interest: arrest decisions based on estimated BACs and actual BACs above and below the criterion level. Table 1 presents the first matrix, with the four major cells representing the four possible decisions at 0.08% BAC. The numbers in the major cells are the frequencies of each type of decision out of the 297 SFST administrations. The two italicized cells in the matrix represent officers' correct decisions: (a) 212 motorists who officers estimated to have BACs ≥0.08% and later were found to have BACs ≥0.08% by BAC testing (by breath, blood, or urine analysis) and (b) 59 motorists who officers estimated to have BACs <0.08% and later tested below 0.08%. The table also shows the incorrect decisions: 22 motorists who officers estimated to have BACs >0.08% but who later were found to have BACs below that level (false positives) and 4 motorists who officers estimated to have BACs below 0.08% and who later tested ≥0.08% (false negatives). Overall, officers' decisions were correct in more than 91% of the cases.

Cohen's kappa test results and a categorical interpretation of agreement also are presented in Table 1. According to Landis and Koch (1977), a κ value of .21 to .40 indicates "fair agreement," .41 to .60 indicates "moderate agreement," .61 to .80 indicates "substantial agreement," and .81 to 1.0 indicates "almost perfect agreement." The κ value of .7628 for all SFST administrations reflects substantial overall agreement between all the officers' decisions (i.e., ≥0.08% or <0.08% BAC) and the actual BACs that were measured later. Table 2 presents a decision matrix, the associated κ score, and the agreement category for each of the 7 participating officers. Officers' individual κ scores ranged from .611 to 1.0; all scores are within the categories of "substantial" and "near perfect" agreement, indicating low variance among the officers and a high degree of interrater reliability.

The officers' arrest decisions based on estimated BACs were inconsistent with the number of HGN clues observed in 7 of the false positive and 2 of the false negative cases; that is, accuracy would have been better had the officers not deviated from the scoring guidelines in these cases. Further, 7 of the false positives had measured BACs of 0.07% or greater, but less than 0.08%, all of which are within the margin of error of the testing devices. A 10th case was a juvenile with a measured BAC of .069%, which rendered the difference between estimated and measured BACs irrelevant in a zero-tolerance jurisdiction; that is, it was a correct arrest decision despite the overestimation of the juvenile's BAC. In addition, two of the motorists with measured BACs of 0.07% were arrested for DWI because the officers believed that they were too impaired to be permitted to drive. Finally, an additional motorist with an estimated BAC of 0.08% and a measured BAC of 0.05% was found to be a psychiatric patient, which helped to explain her erratic behavior, poor SFST performance, and obvious impairment.

Further analyses were performed to explore methods for combining the results of the three component tests. Only the 261 cases that included test results for all three component tests could be used in this analysis. Of those drivers, 73 were found to have BACs <0.08% and 188 had measured BACs ≥0.08%. In 162 of the 188 cases (86%), all three component SFSTs were unanimous in their predictions.

Figure 1 presents a Venn diagram that illustrates the contributions of the three tests to the 14%

TABLE 1: Decision Matrix at 0.08% BAC for All Cases (7 Officers, $n = 297$)

Measured BAC	Estimated BAC ≥0.08%	Estimated BAC <0.08%	Kappa Score	Agreement $p < .05$
≥0.08%	*212*	4	.7628	Substantial
<0.08%	22	*59*		

Note. Numbers in italics indicate officers' correct decisions.

TABLE 2: Decision Matrices at 0.08% BAC for Each Officer

Officer	*n*	Measured BAC	Estimated BAC ≥0.08%	Estimated BAC <0.08%	Kappa Score	Agreement $p < .05$
1	58	≥0.08%	*38*	1	.6110	Substantial
		<0.08%	8	*11*		
2	31	≥0.08%	*24*	0	1.0000	Perfect
		<0.08%	0	*7*		
3	69	≥0.08%	*39*	2	.7859	Substantial
		<0.08%	5	*23*		
4	47	≥0.08%	*41*	0	.6356	Substantial
		<0.08%	3	*3*		
5	44	≥0.08%	*37*	0	.8078	Almost perfect
		<0.08%	2	*5*		
6	25	≥0.08%	*16*	0	.7191	Substantial
		<0.08%	3	*6*		
7	23	≥0.08%	*17*	1	.7444	Substantial
		<0.08%	1	*4*		

Note. Numbers in italics indicate officers' correct decisions.

of cases in which a discrepancy occurred. The figure shows there were 162 cases with BACs ≥0.08 in which all three SFSTs indicated a BAC of ≥0.08 and 26 cases in which one or more tests disagreed (the numbers inside the circles). A single test indicated a BAC <0.08% in 17 of the cases (8 + 2 + 7), and two tests were involved in nine of the cases (1 + 1 + 7). There were no cases in which all three tests predicted incorrectly.

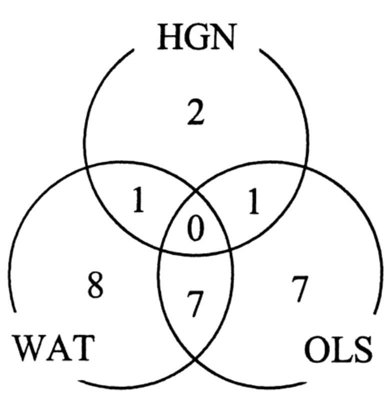

Figure 1. Venn diagram of 188 cases ≥0.08% BAC, showing the 26 cases in which all three tests do not agree. The 162 cases in which all three tests agree are represented by the area outside the three circles. (HGN = horizontal gaze nystagmus test, WAT = walk and turn test, OLS = one-leg stand test.)

The horizontal gaze nystagmus (HGN) test was about four times less likely to be the source of a discrepancy than the other two tests. Only 2 of the single-test discrepancies were attributable to HGN results, compared with 8 cases for the walk and turn test and seven cases for the one-leg stand test. Overall, the HGN test was involved in only 4 of the discrepancies, compared with 16 cases for the walk and turn and 15 cases for the one-leg stand.

The question of the SFST battery's accuracy in discriminating BACs above and below 0.04% is addressed by the decision matrix presented in Table 3; the italicized cells of the matrix again represent correct decisions based on SFST results. The table shows that officers estimated motorists' BACs to be equal to or greater than 0.04% but under 0.08% in 54 cases, and in 51 of those cases their estimates were found to be correct by subsequent breath, blood, or urine testing. The table also shows that officers estimated that 29 motorists had BACs below 0.04%, and in 15 of those cases their estimates were found to be correct by subsequent testing. Overall, officers were accurate in 80% of the cases when discriminating between motorists who were above 0.04% but below 0.08% BAC. However, kappa test results indicated only "moderate" agreement between officers' decisions and measured BACs ($\kappa = .5061$).

TABLE 3: Decision Matrix at 0.04% BAC (All Cases <0.08% BAC; 7 Officers, *n* = 83)

Measured BAC	Estimated BAC ≥0.04%, <0.08%	Estimated BAC <0.04	Kappa Score	Agreement *p* < .05
≥0.04%, <0.08%	*51*	14	.5061	Moderate
<0.04%	3	*15*		

Note. Numbers in italics indicate officers' correct decisions.

DISCUSSION

The research described here found that the SFST battery accurately and reliably assists officers in making DWI arrest decisions at 0.08% BAC. The primary implication of the study results is that the SFST battery is a valid decision aid for making roadside DWI assessments.

The horizontal gaze nystagmus test was found to be the most predictive of the three component tests, but correlations with measured BACs were higher when the results of all three tests were combined, as reported earlier. The implications of this study result are that all components of the SFST battery should be administered when possible or practical. However, the data indicate that the HGN test alone can provide valid indications to support officers' arrest decisions at 0.08% BAC.

Note About the Acceptability of the HGN Test

The horizontal gaze nystagmus (HGN) test is considered by many law enforcement officers to be a foolproof technique (sometimes called a "silver bullet") that provides indisputable evidence of alcohol in a motorist's system. The normal variation in human physical and cognitive capabilities, and the effects of alcohol tolerance, result in uncertainties when arrest decisions are made exclusively on the basis of performance tests. These uncertainties have resulted in large proportions of DWI suspects being released rather than detained and transported to another location for evidentiary chemical testing. This is important because experienced drinkers often can perform physical and cognitive tests acceptably with a BAC greater than 0.10%. However, even the most experienced drinkers cannot conceal the physiological effects of alcohol from an officer skilled in HGN test administration, because nystagmus is an involuntary reaction over which an individual has absolutely no control. Many individuals, including some judges, believe that the purpose of a field sobriety test is to measure driving impairment. For this reason, they tend to expect tests to possess "face validity" – that is, the appearance of being related to actual driving tasks. Tests of physical and cognitive abilities, such as balance, reaction time, and information processing, have face validity, to varying degrees, based on the involvement of these abilities in driving tasks; that is, the tests seem to be relevant "on the face of it." HGN lacks face validity because it does not appear to be linked to the requirements of driving a motor vehicle. The reasoning is correct, but it is based on the incorrect assumption that field sobriety tests are designed to measure driving impairment.

Driving a motor vehicle is a complex activity that involves many tasks and operator capabilities that would be difficult, if not impossible, to measure at roadside. The constraints imposed by field conditions were recognized by the developers of the SFST battery. As a consequence, they pursued the development of tests that would provide valid indications of a driver's BAC, rather than indications of driving impairment. The link between BAC and driving impairment is a separate issue, involving entirely different research methods. Those methods have found driving to be impaired at BACs as low as 0.02%, with a sharp increase in impairment at about 0.07% (Moskowitz & Robinson, 1988; Stuster, 1997). Thus, SFST results help officers to make accurate DWI arrest decisions even though SFSTs do not directly measure driving impairment. HGN's apparent lack of face validity to driving tasks is irrelevant because the objective of the test is to discriminate between drivers above and below the statutory BAC limit, not to measure driving impairment. Throughout the United States, DWI laws permit arrest decisions to be made on the basis of the statutory BAC limit, irrespective of a specific motorist's degree of impairment. Motorists also can be arrested at BACs below the statutory limit if their driving performance is demonstrably impaired by alcohol or other drugs.

CONCLUSIONS

The results of this study provide statistically significant evidence of the validity of the Standardized Field Sobriety Test Battery to discriminate above or below 0.08% BAC. However, only moderate agreement was found when discriminating above and below 0.04% BAC.

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