

Baseline Data and State of the Science: Operating Under the Influence of Cannabis

Public Meeting of the Cannabis Control Commission: January 24, 2019

Julie K. Johnson, Ph.D.
Samantha M. Doonan, B.A.

Presentation Overview

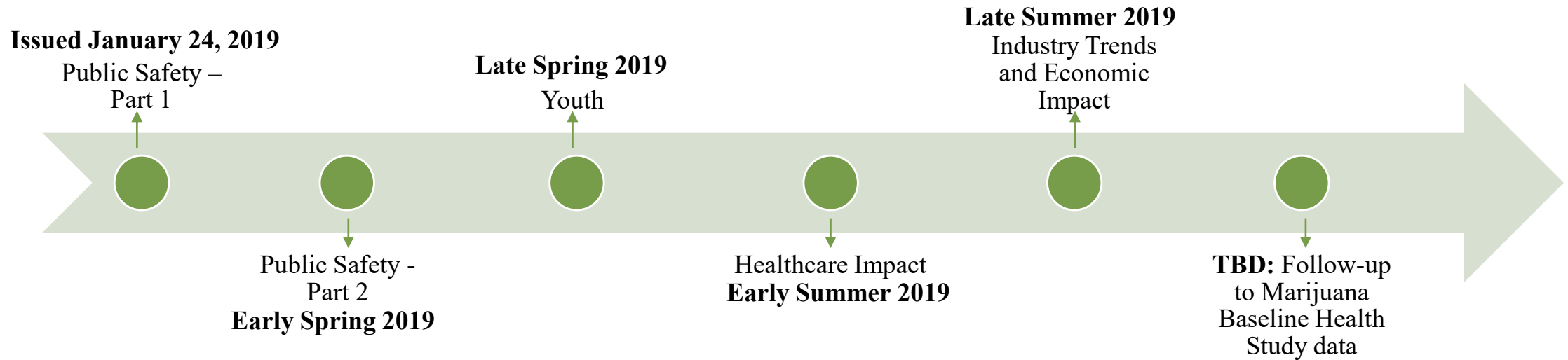
- Statutory Mandate
- Reporting Timeline
- Operating Under the Influence of Cannabis: Literature Review and Preliminary Data in Massachusetts
 - Scope of Report
 - Baseline Data
 - State of the Science
 - Policy Considerations

Chapter 55: An Act to Ensure Safe Access to Marijuana

Section 17. (a) The commission shall develop a research agenda in order to understand the social and economic trends of marijuana in the commonwealth, to inform future decisions that would aid in the closure of the illicit marketplace and to inform the commission on the public health impacts of marijuana. The research agenda shall include, but not be limited to:

- (i) patterns of use, methods of consumption, sources of purchase and general perceptions of marijuana among minors, among college and university students and among adults;
- (ii) incidents of impaired driving, hospitalization and use of other health care services related to marijuana use, including a report of the state of the science around identifying a quantifiable level of marijuana-induced impairment of motor vehicle operation and a report on the financial impacts on the state healthcare system of hospitalizations related to marijuana;**
- (iii) economic and fiscal impacts for state and local governments including the impact of legalization on the production and distribution of marijuana in the illicit market and the costs and benefits to state and local revenue;
- (iv) ownership and employment trends in the marijuana industry examining participation by racial, ethnic and socioeconomic subgroups, including identification of barriers to participation in the industry;
- (v) a market analysis examining the expansion or contraction of the illicit marketplace and the expansion or contraction of the legal marketplace, including estimates and comparisons of pricing and product availability in both markets;
- (vi) a compilation of data on the number of incidents of discipline in schools, including suspensions or expulsions, resulting from marijuana use or possession of marijuana or marijuana products; and
- (vii) a compilation of data on the number of civil penalties, arrests, prosecutions, incarcerations and sanctions imposed for violations of chapter 94C for possession, distribution or trafficking of marijuana or marijuana products, including the age, race, gender, country of origin, state geographic region and average sanctions of the persons charged.

Anticipated 2019 Reports as Mandated by Ch. 55



First Report: A Baseline Review and Assessment of Cannabis Use and Public Safety

**Today's
Focus**

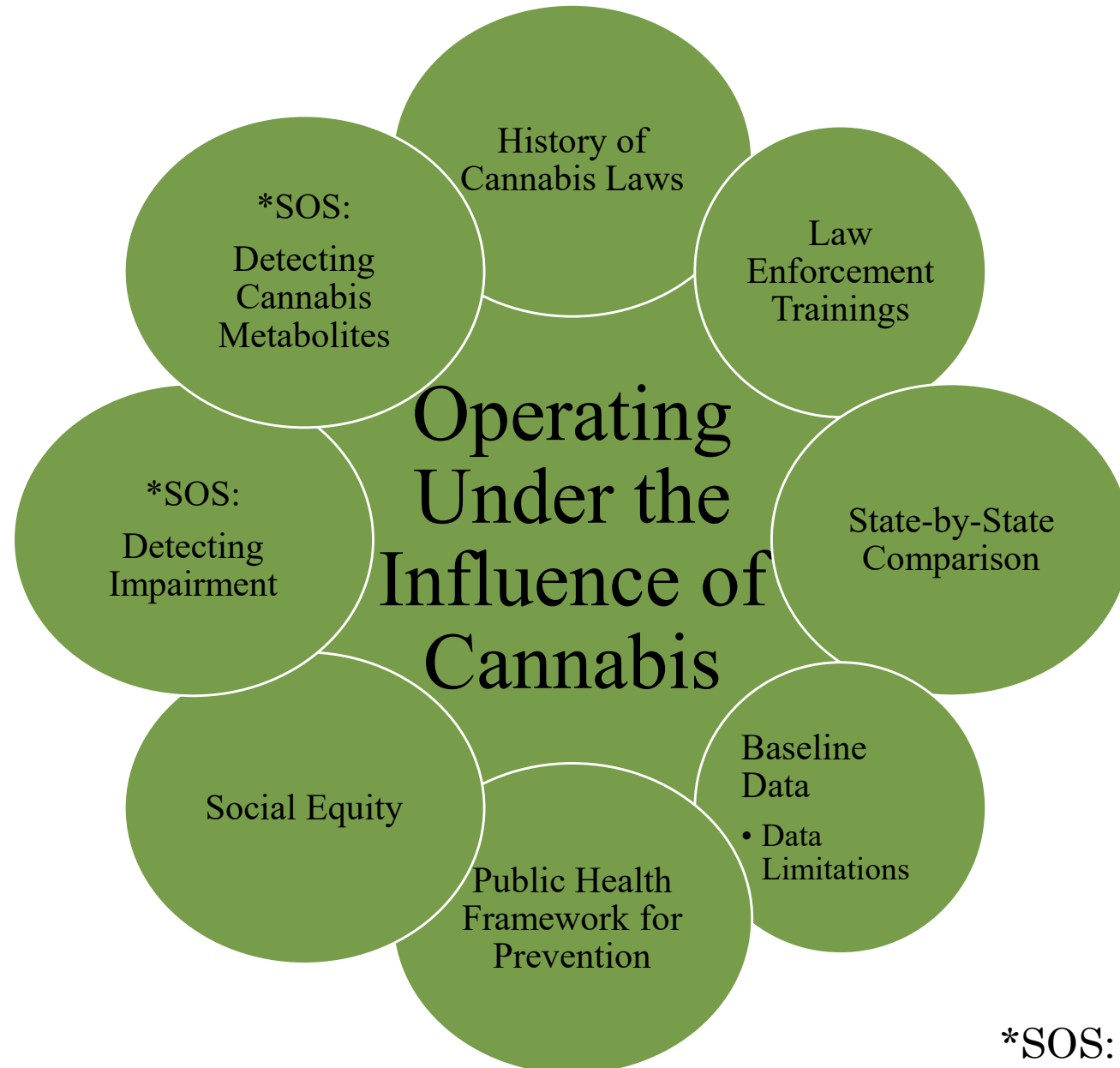
Part 1

Operating Under the Influence of Cannabis:
Literature Review and Preliminary Data in Massachusetts

Part 2

Chapter 94C Violations-- Possession, Distribution of Trafficking of Marijuana or Marijuana Products:
Literature Review and Preliminary Data in Massachusetts

Scope of Issue



Baseline Data Utilized for Report

- Massachusetts (MA) Drug Recognition Expert (DRE) Data;
- MA State Police Operating Under the Influence (OUI) data;
- MA DRE Survey; and
- Public Awareness Campaign, *More About Marijuana*, Focus Groups, Focus Groups surveys, MA Representative Survey, and web analytics.

Trainings Available to Law Enforcement

1. The Standardized Field Sobriety Test (SFST) training (series of 3 tests)

- Horizontal Gaze Nystagmus
- Walk and Turn
- One Leg Stand



Historically used for alcohol-impairment

2. Advanced Roadside Impaired Driving Enforcement (ARIDE) training

Trainings Available to Law Enforcement continued

3. Drug Evaluation and Classification Program/ DRE training (12-steps to identify 7-categories of drugs)

12 Steps

1. Breath Alcohol Test
2. Interview of the Arresting Officer
3. Preliminary Examination and First Pulse
4. Eye Examination
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 the Evaluator
12. Toxicological Examination

Drug categories

- Central Nervous System (CNS)
Depressants
- CNS Stimulants
- Hallucinogens
- Dissociative Anesthetics
- Narcotic Analgesics “Opioids”:
- Inhalants
- Cannabis***

Baseline Data: MA DRE Evaluations

Table 1. Categories of drugs and poly-drug suspected/confirmed by DRE evaluations in Massachusetts, 2010-2017 [Ref. DREs 2010 (63) to 2017 (133)]

DRE YEAR END REPORTS	2010	2011	2012	2013	2014	2015	2016	2017
Drug Category (DRE Opinion)	Frequency [Percent (%)] of total enforcement evaluations							
Depressant	85 (34.7)	149 (38.1)	96 (29.6)	22 (16.8)	89 (30.9)	104 (30.2)	122 (32.3)	170 (33.3)
Stimulant	42 (17.1)	49 (12.5)	30 (9.3)	30 (22.9)	47 (16.3)	42 (12.2)	47 (12.4)	63 (12.4)
Hallucinogen	0 (0.0)	3 (0.8)	6 (1.9)	0 (0.0)	2 (0.7)	2 (0.6)	0 (0.0)	7 (1.4)
Disassociate Anesthetic	4 (1.6)	5 (1.3)	8 (2.5)	3 (2.3)	4 (1.4)	8 (2.3)	13 (3.4)	18 (3.5)
Narcotic Analgesic	111 (45.3)	209 (53.5)	112 (34.6)	28 (21.4)	104 (36.1)	155 (45.1)	147 (38.9)	198 (38.8)
Inhalant	0 (0.0)	1 (0.3)	1 (0.3)	0 (0.0)	3 (1.0)	3 (0.9)	3 (0.8)	2 (0.4)
Cannabis	74 (30.2)	79 (20.2)	74 (22.8)	28 (21.4)	96 (33.3)	85 (24.7)	93 (24.6)	168 (32.9)

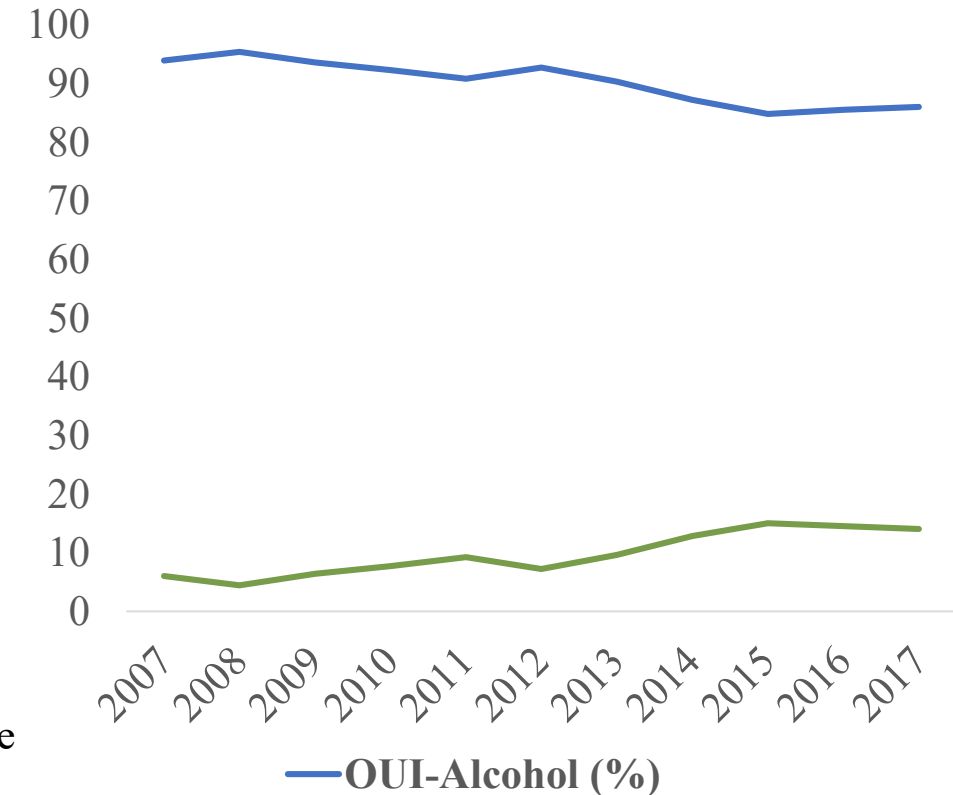
Baseline Data: Massachusetts State Police

Table 3. MSP OUI substance categories stratified by year (frequency [%]), 2007-2017

Year	OUI-Alcohol (%)	OUI-Drugs (%)
2007	3,504 (93.9)	222 (6.0)
2008	5,204 (95.4)	241 (4.4)
2009	4,691 (93.6)	320 (6.4)
2010	4,452 (92.3)	373 (7.7)
2011	3,522 (90.8)	355 (9.2)
2012	4,704 (92.7)	366 (7.2)
2013	3,923 (90.3)	418 (9.6)
2014	4,126 (87.2)	603 (12.8)
2015	3,371 (84.8)	598 (15.0)
2016	3,877 (85.5)	658 (14.5)
2017	2,769 (86.0)	450 (14.0)

MSP OUI data is coded: OUI-Alcohol, OUI-Drugs, OUI-Other Substance

Graph 1. Percent change in OUI-Alcohol (blue) and OUI-Drugs (green), 2007-2017



Baseline Data: DRE Municipality Survey

- All 351 Massachusetts cities and town law enforcement agencies (LEAs) and MA State Police were surveyed by the Commission; **23.6%** of municipalities and the State Police responded
- 46% of LEAs report tracking OUI-Cannabis arrests

Table 2. Years (frequency and percent) of participating LEAs tracking OUI-Cannabis arrests

Years	Frequency	Percent (%) of LEAs
0 Years	60	71.4
1 Year	6	7.1
2 Years	3	3.6
3 Years	4	4.8
5 Years	1	1.2
7 Years	1	1.2
10+ Years	9	10.7

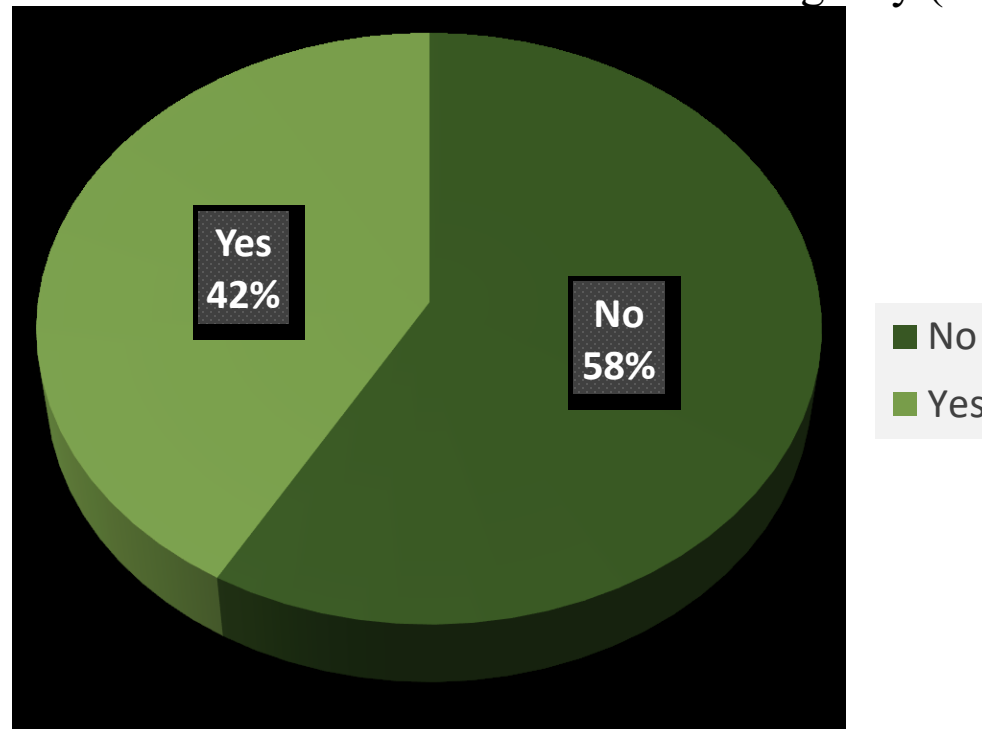
Baseline Data: DRE Municipality Survey

- The most frequently reported impediment to providing DRE certification through their agency were:
 - “resources to pay for the training” (61%) either as the sole reason or in combination with varying other impediments, including:
 - Staffing,
 - Requirements to stay current with certification, or
 - Not useful.
- Only 6.3% reported that “not useful” was the only impediment to providing DRE training through their agency.

Baseline Data: DRE Municipality Survey

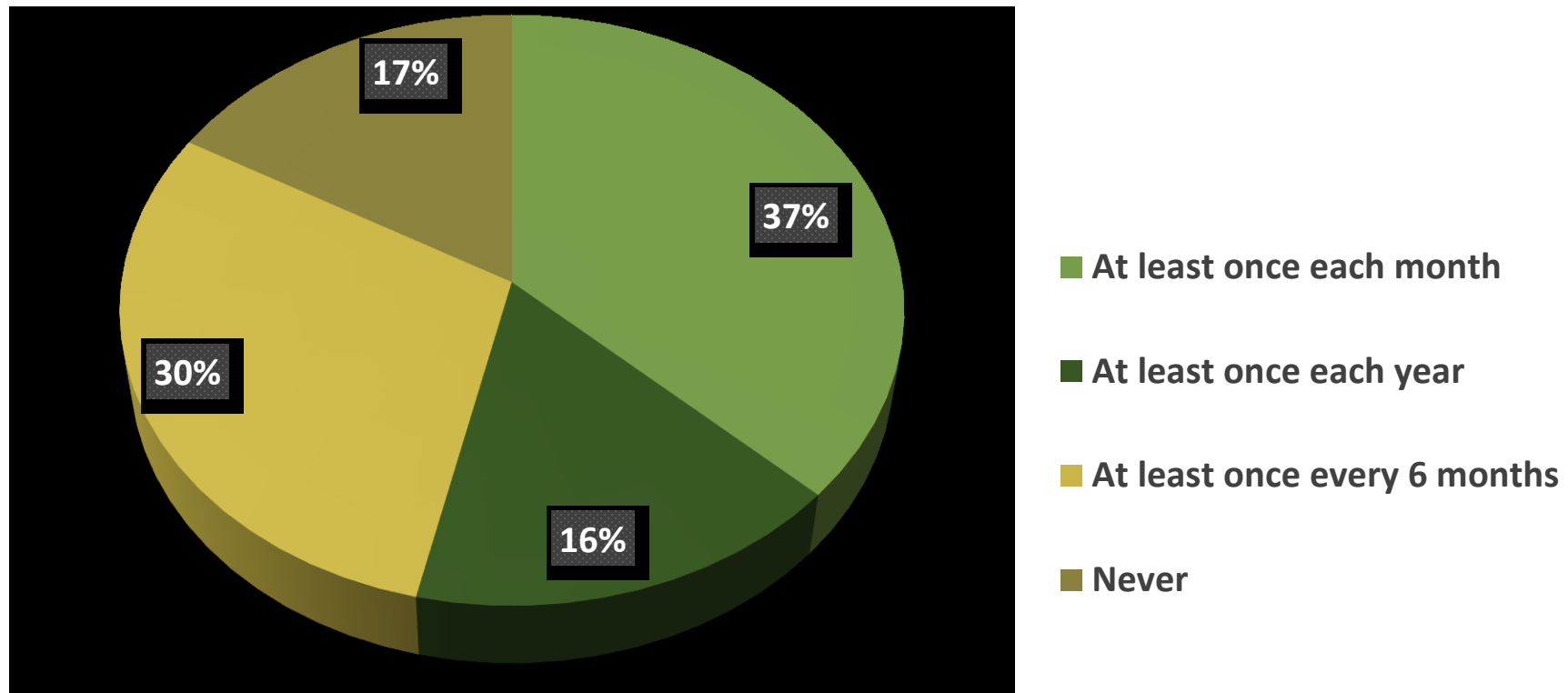
- **73%** of LEAs report having at least one DRE on staff (41.7%) and/or access to one via another LEA (72.6%).
- The length of time municipalities reported having a DRE ranged from “never” to “15+ years.”

Chart 1. LEAs with at least one-DRE trained officer in their Agency (“Department”)



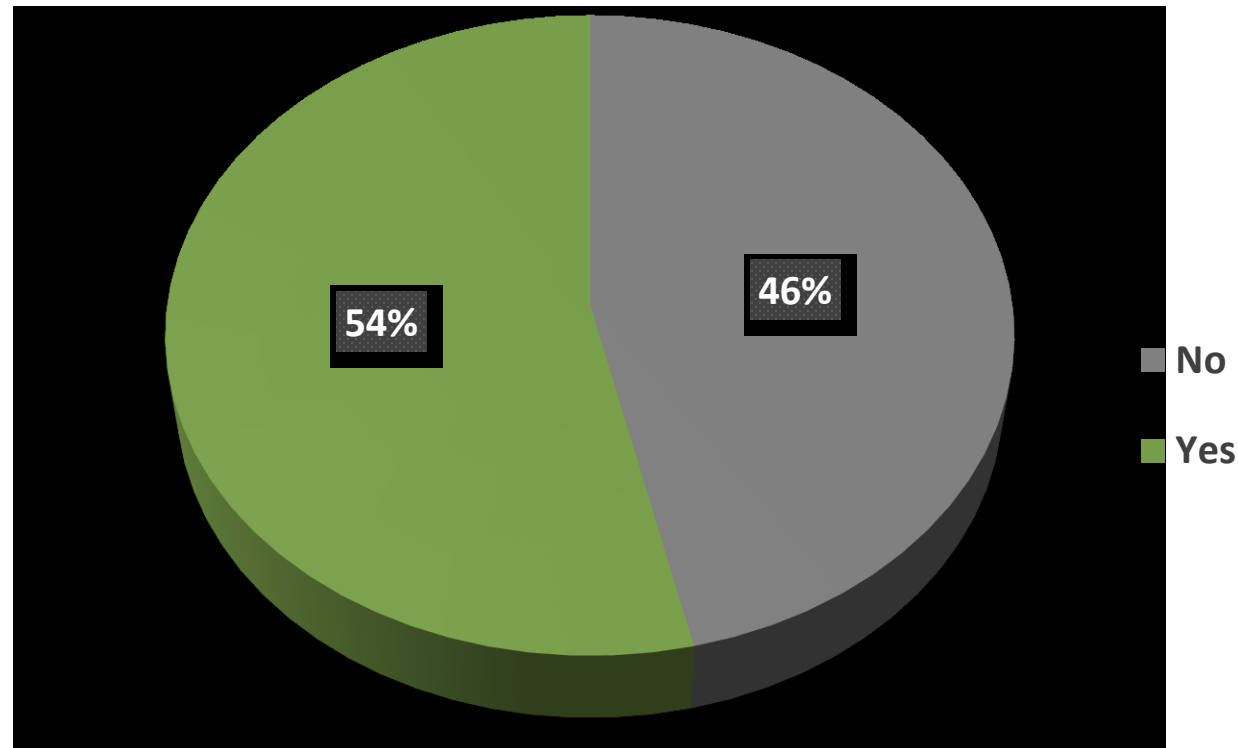
Baseline Data: DRE Municipality Survey

Chart 3. How regularly LEAs with DREs report engaging their services



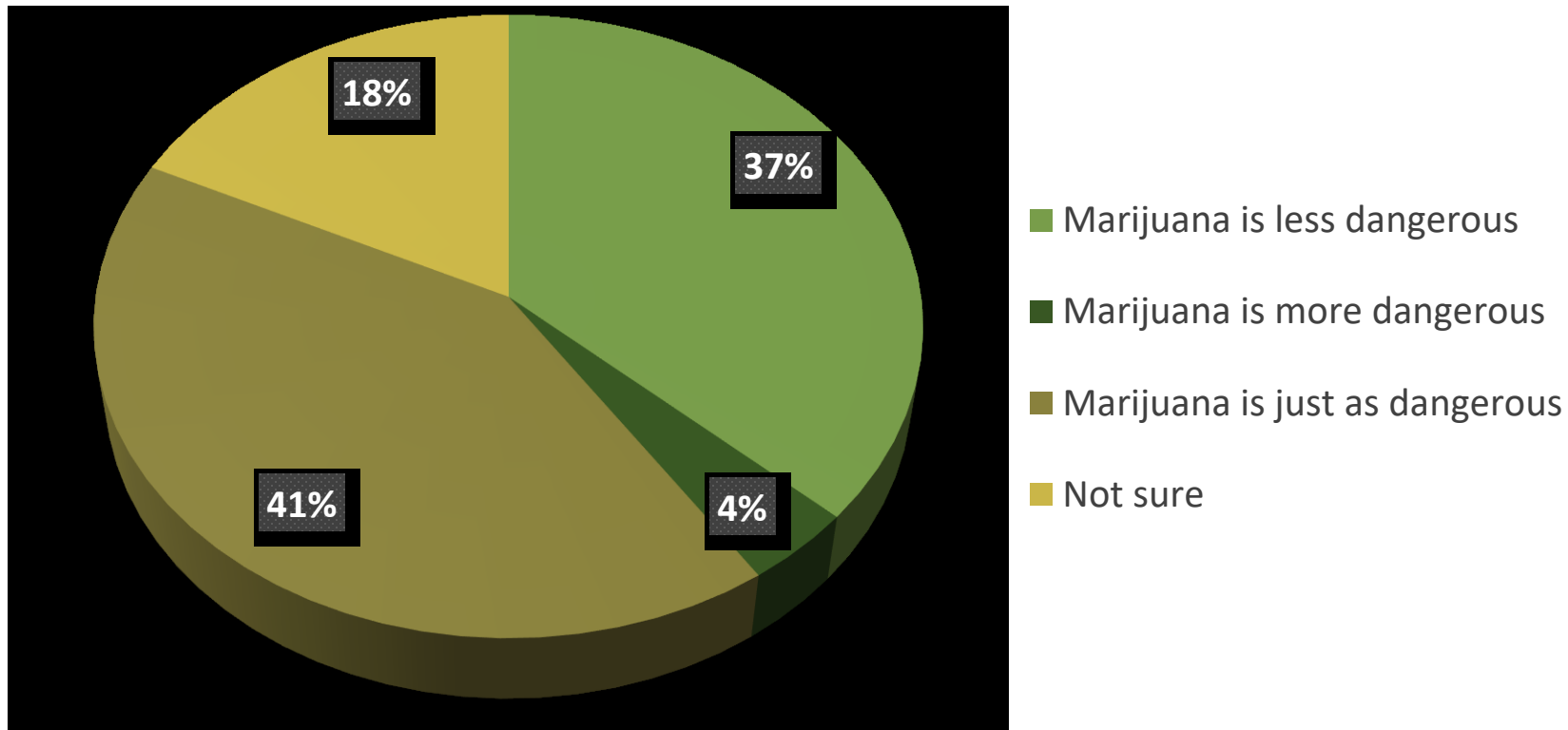
Baseline Data: DRE Municipality Survey

Chart 4. LEAs reporting employment of one or more ARIDE-trained officers



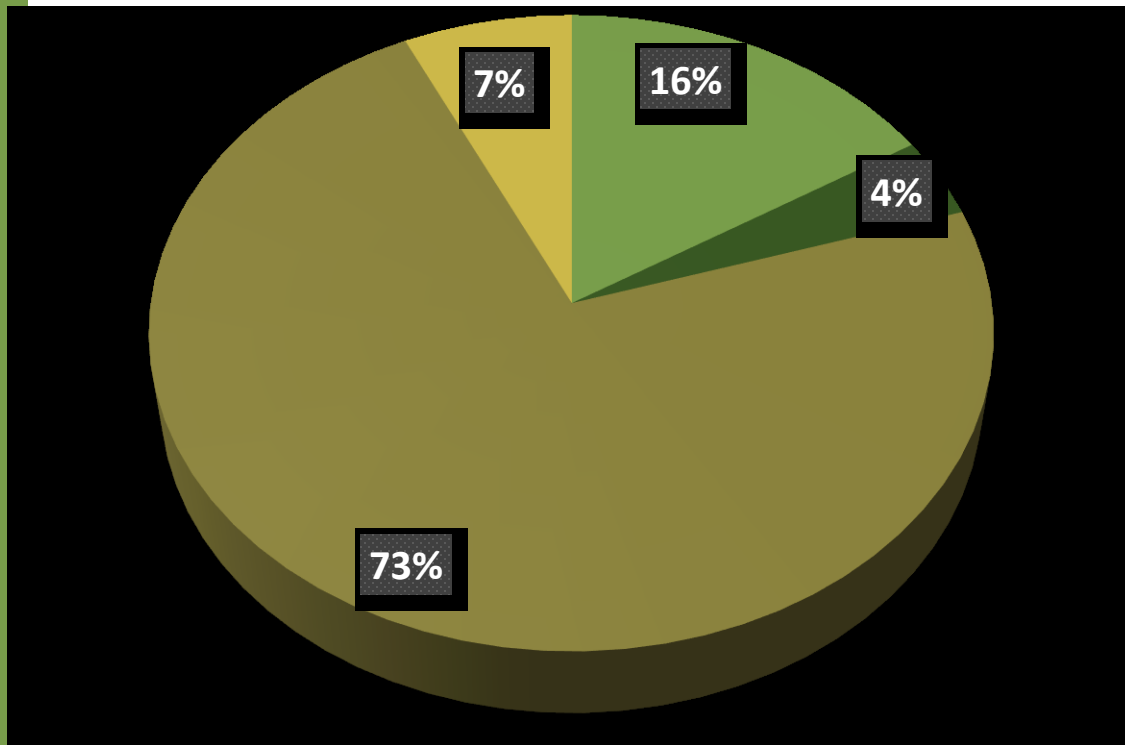
Baseline Data: More About Marijuana

Chart 5. Survey Question: *Is driving after using “marijuana” less dangerous, more dangerous, or equally dangerous as driving after using alcohol?*



Baseline Data: More About Marijuana

Chart 6. Pre-Survey Focus Group Results: Survey Question: *Is driving after using “marijuana” less dangerous, more dangerous, or equally dangerous as driving after using alcohol?*



- Marijuana is less dangerous
- Marijuana is more dangerous
- Marijuana is just as dangerous
- Not sure



States with Adult-Use Cannabis

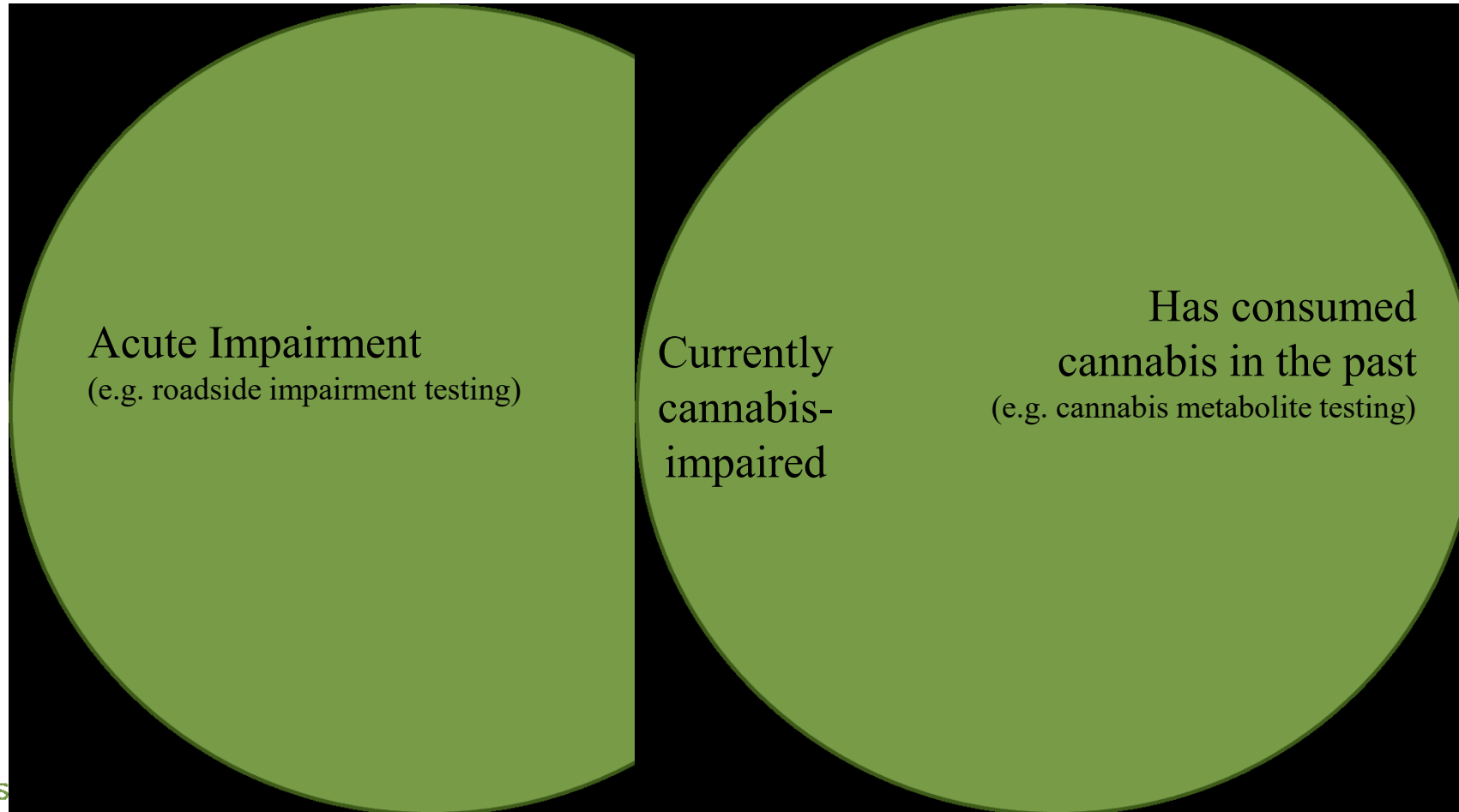
State	Implied consent for cannabis?	# Certified DREs in State (2017) ¹	Per se laws	Legal THC Limit in blood
Alaska	No	40	None	
California	Yes (blood and urine)	1,579	None	
Colorado	Yes (breath, blood, or urine)	211 (228 as of May 2018)	Permissible inference of 5 ng/ml	
Maine	Yes (breath, blood, urine)	98	None	
Massachusetts	No	133	None	
Michigan	Yes (unknown)	97	Zero tolerance – Except in cases of medical marijuana where impairment must be shown.	0 ng/ml
Nevada	Yes (blood, urine)	113	Per se (blood and urine)	2 ng/ml (10ng/ml in urine)
Oregon	Yes (breath, blood, urine)	213	None	
Vermont	Yes (breath, blood, urine)	53	None	
Washington	Yes (breath, blood)	202	Per se	5 ng/ml
District of Columbia (D.C.)	Yes (breath, blood, urine)	9	None	

The Issue:

Detecting Cannabis Impairment vs. Cannabis Metabolites

Cannabis Impairment

Cannabis Metabolites



State of the Science: Research Methods

- Literature search in PubMed and GoogleScholar
- Academic articles from past decade prioritized
- Limited to acute effects
- Findings are grouped by topic and outcome
 - Detecting Impairment
 - Detecting Cannabinoids



State of the Science: Standardized Field Sobriety Test

Take away: Mixed findings; If SFST is sole detector of impairment, impaired drivers may be missed.

- Three studies conclude SFST is a moderately good predictor of THC impairment.²⁻⁴
- One concludes that SFST is mildly sensitive to cannabis impairment in heavy users, although study did not find a difference between baseline and impaired SFST score.⁵
- One found the SFST not sensitive despite observing differences in driving simulator.⁶
- Three studies found that SFST is moderately predictive⁴ or more sensitive^{5,7} to cannabis and alcohol combined (“co-use”)
- Three studies found no correlation between SFST and THC blood concentrations.⁸⁻¹⁰

State of the Science: Drug Recognition Experts (DRE)

Take away: More validity than SFST-- but not a silver bullet → Need more research

- Study variability, methodology differences, mixed findings;
- Three studies report overall accuracy of DRE officers for **cannabis-positive** drivers;
- Certain tests within the 12-step process are more sensitive to cannabis:
 - E.g. Hartman et al. 2016's identified a model with the best sensitivity and specificity:
 - Meeting 2:4 criterion: $3 \leq$ misses of finger to nose, eyelid tremors during [modified Romberg balance], $2 \leq$ clues on the one leg stand, and $2 \leq$ clues on the walk and turn [sensitivity- 97%; specificity- 96.7%].¹⁴

State of the Science: Detecting Cannabinoids—Blood

Take away: Blood tests indicate past use—but not impairment, and likely not feasible in MA.

- Best approximate to brain levels;
- Does not indicate impairment:
 - Counter-clockwise hysteresis pattern;
- Variables affecting detection:
 - Time since consumption;
 - Dose and method of consumption,
 - Use history,
 - Absorption rates, and
 - Metabolism;
- Lacks feasibility in Massachusetts:
 - Cost, timing, warrant, and
 - Per se not based on science.

State of the Science: Detecting Cannabinoids – Urine

Take away: Urine tests indicate past use— but not impairment.

- Urine is the most frequently used specimen by DREs in MA;
- THC-COOH (“carboxy THC”): is the primary metabolite of THC and it is inactive;
- Does not indicate impairment:
 - THC-COOH can typically be detected in urine 30-minutes after cannabis use,¹⁵ but for some, can be detected 30≤ days after use.^{16,17}
- Variables affecting detection:¹⁷
 - Cannabis use history,
 - Body fat,
 - Urine dilution,
 - Timing of test, and
 - Sensitivity of urine testing method.

State of the Science: Detecting Cannabinoids – Oral Fluid

Take away: Oral fluid detects past use— but not impairment, shorter detection length than methods, and mixed findings related to device sensitivity and specificity.

- Oral fluid is the saliva, mucus, and food particles in the mouth;
- Advantages of oral fluid:
 - Speed,
 - Ease of collection, and
 - Roadside collection.
- Disadvantages of oral fluid:
 - Does not measure impairment,
 - THC-positive samples interspersed with negative samples, and
 - Devices imperfect.

State of the Science: Oral Fluid Pilot Programs

Take away: Oral fluid is received well by law enforcement, can help build a case but cannot be used solely to indicate impairment.

- Many states have conducted pilot studies with oral fluid devices:
 - Most pilots tested Alere DDS2 (now “Abbott”) and Dräger DrugTest 5000;
- “Final Report: Massachusetts Oral Fluid Drug Testing Study”¹⁸
 - Overall accuracy for all drugs: 92.6% and 92.5%;
- Key Theme(s): Presumptive value, not absolute
 - False positive and negative can occur;¹⁸
 - Oral fluid devices may not replace DREs; rather, screening may serve to identify more drivers under the influence of drugs, thereby enhancing the need for officers trained [as DREs].¹⁹

Research Gaps: Overview

- Samples/cohorts of interest (*e.g. medicinal, new drivers*);
- Type of cannabis used (*e.g. concentrates*);
- Methods of consumption (*e.g. vaporizing, “dabbing”*);
- Unexpected events/divided attention while driving;
- Tolerance;
- SFST validity;
- DRE validity;
- Quantitative/qualitative law enforcement need(s); and
- Oral fluid detection by consumption method(s).

Policy Considerations: Statutory

- **Consideration 1:** General Law, C. 90, section 24
 - Consider replacing “drugs,” with more inclusive terminology (*e.g. “any substance or substance(s) in combination used to impairment.”*);
 - Consider changing implied consent as any refusal of any reasonable test recommended and conducted by law enforcement to detect potential substance impairment;
 - Consider changing driver ramifications for refusal for “any test of impairment by law enforcement” to be equivalent to the current ramifications for breathalyzer test refusal;
 - Consider differential penalties for drivers found impaired by multiple substances (*e.g. alcohol and cannabis co-use impairment etc.*); and
 - Consider substance use screening for problematic cannabis use for first-time cannabis-impaired driving offenders and recommending treatment for repeat offenders.
- **Consideration 2:** Continuing a form of recent special commission on operating under the influence and impaired driving focused on cannabis; and
- **Consideration 3:** Consider alternatives to a per se limit.

Policy Considerations: Law Enforcement, Criminal Justice, and Emergency Services

- **Consideration 1:** All law enforcement officers (LEOs) certified in ARIDE training after 1-year field patrol experience;
- **Consideration 2:** More LEOs to be certified as DREs;
- **Consideration 3:** Research collaboration to: Assess 1-3 empirically validated questions for LEOs to ask drivers roadside to assist in discerning impairment of: alcohol, cannabis, or any substance or substance(s) used in combination;
- **Consideration 4:** DRE training for EMS w/ CME credits;
- **Consideration 5:** Training for criminal justice professionals (e.g. Prosecutors, Judges, Toxicologists); and
- **Consideration 6:** Toxicology training for LEOs & personnel tasked with collecting biological samples (urine, oral, blood, other) to ensure validity.

Policy Considerations: Data Collection & Monitoring-Public Safety

- **Consideration 1:** LEAs to systematically change OUI coding cases to additionally include a subsection for ‘Cannabis’ (in addition to ‘Alcohol’ and ‘Other Drugs’) so research can compare across substance categories, jurisdictions, and years of data.
 - **If multiple substances: Denote primary and secondary drug category of impairment; and
(*e.g. Two substances in OUI case: Alcohol [primary], Cannabis [secondary] etc.*).
- **Consideration 2:** Sending DREs or other personnel trained in collecting human specimen cannabinoid samples to systematically collect human specimen samples at all crashes (fatal and non-fatal) to assist in determining whether any substance or combination of substance(s) were in the driver’s system at time of crash.

Policy Considerations: Data Collection & Monitoring— Public Safety

- **Consideration 3:** The Commonwealth could consider adding tracking mechanism for “substance impairment” or “substance use and impairment expected” call to form through MA Ambulance Trip Record Information System (MATRIS);
- **Consideration 4:** All Massachusetts LEAs could track the race/ethnicity of all persons pulled over for suspected cannabis impairment stops, as well as arrests, citations, and prosecutions for suspected cannabis-related incidents; and
- **Consideration 5:** LEAs to track DRE and ARIDE-trained LEO:
 - Rates per municipality to ensure parity; and
 - Demographics

Policy Considerations: Data Collection & Monitoring- Patterns of Trends of Driving/Riding Behaviors

- **Considerations 1-2:** The Commonwealth could consider adding measures to the MA-Behavioral Risk Factor Surveillance System (BRFSS) and to the MA-Youth Risk Behavioral Surveillance System (YRBSS) to assess:
 - Past 30-day driving after any cannabis consumption behaviors (*e.g. smoke, eat, drink, vaporize, dab, etc.*);
 - Past 30-day riding with a driver who had recently consumed any cannabis product behaviors (*e.g. smoke, eat, drink, vaporize, dab, etc.*);
 - Perceived social norms of driving after cannabis use (*i.e. how often do people you know drive a motorized vehicle after cannabis consumption etc.*); and
 - Perceived risk of harm from driving after cannabis consumption (*i.e. how risky do people perceive driving after cannabis consumption to be etc.*).

Policy Considerations: Education

Consideration 1: The Commission, in collaboration relevant state agencies could continue public education via public awareness campaigns targeting youth, Massachusetts constituents, and drivers at risk, including efforts to educate on:

- Laws and statutes of OUI-cannabis, especially if there are changes to Massachusetts General Law, C. 90, section 24 and the implied consent law;
- Dangers of driving after cannabis use;
- Differential effects of varying products and methods of consumption; and
- Common misconceptions (*e.g. subjective perception of better ability to drive after cannabis use*)

Additionally: To be inclusive, all education materials should be inclusive, multi-lingual, and reach all affected communities.

References

1. International Association of Chiefs of Police. Annual Report of the IACP Drug Evaluation & Classification Program.; 2017.
2. Papafotiou K, Carter JD, Stough C. The relationship between performance on the standardised field sobriety tests, driving performance and the level of Δ^9 -tetrahydrocannabinol (THC) in blood. *Forensic Sci Int*. 2005;155(2-3):172-178. doi:10.1016/j.forsciint.2004.11.009
3. Papafotiou K, Carter JD, Stough C. An evaluation of the sensitivity of the Standardised Field Sobriety Tests (SFSTs) to detect impairment due to marijuana intoxication. *Psychopharmacology (Berl)*. 2005;180(1):107-114. doi:10.1007/s00213-004-2119-9
4. Logan B, Kacinko SL, Beirness DJ. *An Evaluation of Data from Drivers Arrested for Driving Under the Influence in Relation to Per Se Limits for Cannabis*.; 2016. <https://www.aaafoundation.org/sites/default/files/EvaluationOfDriversInRelationToPerSeReport.pdf> <https://trid.trb.org/view/1409220>.
5. Newmeyer MN, Swortwood MJ, Taylor ME, Abulseoud OA, Woodward TH, Huestis MA. Evaluation of divided attention psychophysical task performance and effects on pupil sizes following smoked, vaporized and oral cannabis administration. *J Appl Toxicol*. 2017;37(8):922-932. doi:10.1002/jat.3440
6. Beirness DJ, Beasley E, Lecavalier J. The accuracy of evaluations by drug recognition experts in Canada. *J Can Soc Forensic Sci*. 2009;42(1):75-79. doi:10.1080/00085030.2009.10757598
7. Porath-Waller AJ, Beirness DJ, Beasley EE. Toward a more parsimonious approach to drug recognition expert evaluations. *Traffic Inj Prev*. 2009;10(6):513-518. doi:10.1080/15389580903191617
8. Bondallaz P, Favrat B, Chtioui H, Fornari E, Maeder P, Giroud C. Cannabis and its effects on driving skills. *Forensic Sci Int*. 2016;268:92-102. doi:10.1016/j.forsciint.2016.09.007
9. Musshoff F, Madea B. Review of biologic matrices (urine, blood, hair) as indicators of recent or ongoing cannabis use. *Ther Drug Monit*. 2006;28(2):155-163. doi:10.1097/01.fid.0000197091.07807.22
10. Vandrey R, Herrmann ES, Mitchell JM, et al. Pharmacokinetic Profile of Oral Cannabis in Humans: Blood and Oral Fluid Disposition and Relation to Pharmacodynamic Outcomes. *J Anal Toxicol*. 2017;41(2):83-99. doi:10.1093/jat/bkx012
11. Bosker WM, Theunissen EL, Conen S, et al. A placebo-controlled study to assess standardized field sobriety tests performance during alcohol and cannabis intoxication in heavy cannabis users and accuracy of point of collection testing devices for detecting the in oral fluid. *Psychopharmacology (Berl)*. 2012;223(4):439-446. doi:10.1007/s00213-012-2732-y
12. Downey LA, King R, Papafotiou K, et al. Detecting impairment associated with cannabis with and without alcohol on the Standardized Field Sobriety Tests. *Psychopharmacology (Berl)*. 2012;224(4):581-589. doi:10.1007/s00213-012-2787-9
13. Stough C, Boorman M, Ogden E, Papafotiou K. *An Evaluation of the Standardised Field Tests with Cannabis and with and without Alcohol*. Canberra, Australia, Australia; 2006.
14. Crean RD, Crane NA, Mason BJ. An evidence based review of acute and long-term effects of cannabis use on executive cognitive functions. *J Addict Med*. 2011;5(1):1-8. doi:10.1097/ADM.0b013e31820c23fa.An
15. Bramness JG, Khiabani HZ, Mørland J. Impairment due to cannabis and ethanol: Clinical signs and additive effects. *Addiction*. 2010;105(6):1080-1087. doi:10.1111/j.1360-0443.2010.02911.x
16. Porath-Waller AJ, Beirness DJ. An Examination of the Validity of the Standardized Field Sobriety Test in Detecting Drug Impairment Using Data from the Drug Evaluation and Classification Program. *Traffic Inj Prev*. 2014;15(2):125-131. doi:10.1080/15389588.2013.800638
17. Declues K, Perez S, Figueroa A. A 2-Year Study of Δ^9 -tetrahydrocannabinol Concentrations in Drivers: Examining Driving and Field Sobriety Test Performance. *J Forensic Sci*. 2016;61(6):1664-1670. doi:10.1111/1556-4029.13168
18. Pehrsson A, Blencowe T, Vimpari K, Langel K, Engblom C, Lillsunde P. An evaluation of on-site oral fluid drug screening devices drugwipe® 5+and rapid STAT® using oral fluid for confirmation analysis. *J Anal Toxicol*. 2011;35(4):211-218.
19. Beirness DJ, Smith DR. An assessment of oral fluid drug screening devices. *Can Soc Forensic Sci J*. 2017;50(2):55-63. doi:10.1080/00085030.2017.1258212