TERMINOLOGY

Should I say cannabis or marijuana?

- “Cannabis” is the preferred term
- Canada spells it with an ”H” (marihuana)
- The term Marijuana is an Anti-Mexican slur linked to the Marijuana Tax Act (1937)
- The botanical term is fine - in Europe they use the name “herbal cannabis”
ACTIVE INGREDIENT(S) IN WHOLE PLANT CANNABIS

- delta-9-tetrahydrocannabinol (THC) is the main psychoactive ingredient in cannabis

- Plus:
  - 60-70 other cannabinoids (known as phytocannabinoids i.e. THC, CBD, CBN, CBC, CBG, etc....)
  - 120 terpenoids (i.e. pinene, myrcene, linalool and limonene)
  - 21 flavonoids
  - 11 plant sterols (in the seed)
  - 22 fatty acids
2.5% of the world’s population consumes cannabis (annual prevalence, WHO, 2016)
  • 0.2% consume cocaine
  • 0.2% consume opiates

9.5% of Americans use cannabis (NIH)
  • North America reports a much higher usage rate (WHO, 2016)

13.6% percent of Colorado adults use cannabis
  • (Monitoring Health Concerns Related to Marijuana in Colorado: 2016 report)
PREVALENCE AMONG U.S. ADULTS

- Americans who reported using cannabis in the past year more than doubled between 2001-2002 and 2012-2013

- 30% of users meet criteria for cannabis use disorder
  - Compared to opioid-use disorder where 35% meet DSM V criteria for (Boscarino, 2011)
• 8.3% of adults used cannabis in the past month (approximately 22.2 million people) (SAMHSA, 2015)

• 19.8% of people aged 18 to 25 used cannabis in the past month
  • Cannabis use is most prevalent among people aged 18 to 25

• 7.0% of people aged 12 to 17 reported cannabis use in the past month
• Kids should delay cannabis use until adulthood: after age 18, or even 21 (Canada's Lower-Risk Cannabis Use Guidelines, 2017)
  • Strong evidence that cannabis can affect the developing brain (crystallized intelligence – not IQ)

• Some argue for age 25 as the legal limit
  • This links neuromaturation with public policy (Johnson et al., 2009)
  • Underage DUIC is a zero-tolerance (positive) test
USPSTF RECOMMENDATIONS: THERE IS INSUFFICIENT EVIDENCE ASSESSING BENEFITS AND HARMS OF CANNABIS SCREENING – NOTHING ON DUIC

• SOME EVIDENCE THAT CANNABIS USE MAY LEAD TO INCREASED RISK FOR MOTOR VEHICLE CRASHES

• Motor vehicle crashes are the leading cause of death among 10-24 year olds
  • The Federal Bureau of Investigation (FBI) reports more than 1.1 million driving under the influence (DUI) arrests in 2013
  • Cannabis users have demographic characteristics that are similar to those of other groups with a high crash risk including youth, males, and those with a high prevalence of drugged and drunk driving (Bergeron and Paquette, 2014; Richer and Bergeron, 2009)
THE HEALTH EFFECTS OF CANNABIS AND CANNABINOIDS: THE CURRENT STATE OF EVIDENCE AND RECOMMENDATIONS FOR RESEARCH

ACCORDING TO THE NATIONAL ACADEMY OF SCIENCES

- We need more research to understand the effects of cannabis use on the incidence and severity of motor vehicle crashes.

- There have been a total of six systematic reviews of fair or good quality that summarize DUIC and MVCs.
  - Unfortunately, some studies use driving simulations as opposed to real world scenarios.

- Risks associated with DUIC underscore the need for rapid, noninvasive methods of assessing acute cannabis intoxication.
CDC GUIDELINES: IMPACT ON DRIVING

1. Slowed reaction time + slowed decision-making

2. Impaired coordination, distorted perception, difficulty problem solving

3. Combining alcohol with cannabis creates a greater risk than either substance alone (Rogeberg and Elvik, 2016)
CDC GUIDELINES: RISK OF CAR CRASHES

1. It is unclear whether cannabis use actually increases the risk of car crashes
   • Missing accurate roadside test (field sobriety test/"cannabis breathalyzer")
   • Cannabis will remain in a user’s system for days or weeks

2. Drivers are not always tested for drug use
   • BAC is enough evidence for a driving-while-impaired charge
   • Alcohol and/or multiple drugs make it hard to know which substance contributed to the crash
ACUTE INTOXICATION TESTING: LINEAR VS. NONLINEAR METABOLISM

- Alcohol is metabolized in a linear fashion
  - Blood alcohol concentration (BAC) can be easily calculated

- Metabolism of **THC is dramatically non-linear** (Huestis et al. 1992; Toennes et al. 2008).
  - Cannabis is fat soluble
  - Almost impossible to pinpoint the exact time of consumption
# PROLIFERATION OF INADEQUATE TESTING

<table>
<thead>
<tr>
<th>Type of Test</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine Analysis³</td>
<td>- cheapest and most common form of drug test</td>
<td>- limits of detection/not very sensitive³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- subject to attempts at adulteration (creatinine) and substitution¹, ¹⁵</td>
</tr>
<tr>
<td>Hair Analysis⁸</td>
<td>- non-invasive</td>
<td>- in the case of a positive ELISA hair test, a confirmatory analysis is needed (this is true for all tests)</td>
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<td></td>
<td>- no false negative results</td>
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<td></td>
<td>- easy to administer and process</td>
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<tr>
<td></td>
<td>- GC-MS confirmation can be realized with the same preparation medium used for the screening test</td>
<td></td>
</tr>
<tr>
<td>Blood Plasma Concentration³</td>
<td>- very sensitive</td>
<td>- invasive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- added time delay for blood draw</td>
</tr>
<tr>
<td>Oral Fluid Analysis³</td>
<td>- considered the main alternative to blood plasma to document recent use of medicines or drugs of abuse</td>
<td>- oral fluid testing is not comparable in accuracy to urine on-site testing</td>
</tr>
<tr>
<td>(Salivette®)</td>
<td>- results appear earlier than in sweat testing</td>
<td>- subject to choice of collection protocol</td>
</tr>
<tr>
<td></td>
<td>- THC generally quantifiable for 48 hrs. CBD and CBN detectable at admission only.¹¹</td>
<td>- decrease in salivary flow after cannabis smoking</td>
</tr>
<tr>
<td>Sweat Analysis³, ⁷, ⁹, ¹⁴ (Drugwipes ®) (PharmChek®)</td>
<td>- less invasive than blood testing</td>
<td>- THC is not water soluble and the amount of THC in sweat is low and requires very sensitive analytical methods</td>
</tr>
<tr>
<td></td>
<td>- may have some applications in driving under the influence because police find the test easy to use³</td>
<td>- sweat test has a longer delay in the appearance of drugs compared to other tests</td>
</tr>
<tr>
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<td>- THC is not water soluble and the amount of THC in sweat is low and requires very sensitive analytical methods</td>
<td>- not suitable for field sobriety because daily cannabis users will have a positive sweat patch in the first week after ceasing drug use⁷</td>
</tr>
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<td>- skin may be susceptible to external contamination⁷.</td>
</tr>
<tr>
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<td></td>
<td>- a positive test is only an indication of recent use and is not necessarily related to a positive plasma result</td>
</tr>
<tr>
<td></td>
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<td>- may be best for use in treatment or criminal justice applications rather than employment</td>
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<tr>
<td></td>
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<td>- very few studies on THC excretion in sweat for this reason some metabolites are missed in sweat testing</td>
</tr>
</tbody>
</table>
DUIC: METHODS OF INGESTION

• Different methods of cannabis use lead to different levels of impairment

• Resolution of impairment
  • Wait **6 hours after smoking** cannabis (35 mg or less THC) before driving, biking, or performing other safety-sensitive activities
  • Wait **8 hours after eating or drinking cannabis** (18 mg THC or less) before driving, biking, or performing other safety-sensitive activities

• **Secondhand cannabis exposure** evidence shows that passive exposure **under usual conditions would not test above standard cutoffs** for workplace urine test or driving impairment blood test (Berthet, 2016)
HOW DO STATE LAWS IMPACT DRIVER ATTITUDES AROUND DUIC?

• Some Good News
  • In CO, it is **illegal to use cannabis in a vehicle**
  • open container law applies to cannabis (C.R.S. § 42-4-1305.5)

• Some Bad News
  • In CO, single-serving edible cannabis product should not contain more than 10 mg of THC
    • However, retail sales of **cookies and brownies - generally understood to be single-serving products** - **contain as much as 100 mg THC (or 10 servings)** (Colorado Code of Regulations. Department of Revenue. Marijuana Enforcement Division. Retail Marijuana Rules. 1 CCR 212-2 R604 (C5) (2))

• Some Nuanced News
  • In both CO and WA
    • **blood contains 5 ng/ml THC considered to be under the influence and is guilty of DUIC**
ATTITUDES ABOUT DRIVING WHILE HIGH: CO AND WA

- 23.9% self-report driving within 1 hour of using cannabis at least 5 times in the past month

- 43.6% of respondents self-report driving while under the influence of cannabis once in a given year (where n = 865) (Davis, 2016)
### INTERNATIONAL* LAWS ON DUIC

Table 1  
Overview of DUIC laws and relevant evaluations.

<table>
<thead>
<tr>
<th>Type of Law</th>
<th>Example Jurisdictions</th>
<th>Published Evaluations</th>
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<tr>
<td>Zero tolerance</td>
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<tr>
<td>Any evidence of cannabis use preceding driving (e.g., any detection of THC or THC-COOH in the driver's body) is an offence</td>
<td>Sweden, Slovenia, Arizona</td>
<td>Sweden: B-Holmgren et al. (2008); C-Jones (2005)</td>
</tr>
<tr>
<td>Behavioural impairment</td>
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<tr>
<td>Evidence of behavioural impairment (e.g., assessed by standardized field sobriety tests or DRE exam) is an offence</td>
<td>Canada, Hungary, Spain</td>
<td>Canada: C-Cook et al. (in press); C-Solomon and Chamberlain (2014); B, C-Stoduto et al. (2014)</td>
</tr>
<tr>
<td>Per se (non-zero)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evidence of the presence of THC and/or THC-COOH in bodily fluid over a specified threshold is an offence</td>
<td>Denmark (1.0 μg/L in blood); Norway (1.3 μg/L in blood; also specified THC levels comparable to BAC); Washington (5.0 μg/L in blood)</td>
<td>Denmark: C-Steenoft et al. (2010); Norway: C-Vindenes et al. (2014); U.S.: A-Anderson and Rees (2015)</td>
</tr>
<tr>
<td>Hybrid/two-tier</td>
<td></td>
<td></td>
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<tr>
<td>Jurisdictions that have a combination of zero-tolerance, behavioural impairment, and/or per se laws in determining an offence, or where two or more levels of an offence are defined where one could be triggered by behavioural impairment and the other by exceeding a per se level, or where tiered offences involving different per se levels are defined</td>
<td>Australia, Belgium, Germany</td>
<td>Australia: C-Boorman and Owens (2009); C-Davey et al. (2014)</td>
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**SOURCE:** WATSON, 2016
## INTERNATIONAL LAWS ON DUIC

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<td>Behavioural impairment</td>
<td>Canada, Hungary, Spain</td>
<td>Issues with non-specific testing. Cannabis stays in the bloodstream/adipose tissue for 30-45 days</td>
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<tr>
<td>Per se (non-zero)</td>
<td>Denmark (1.0 µg/L in blood); Norway (1.3 µg/L in blood; also specified THC levels comparable to BAC)</td>
<td>Expensive and subjective. Not always admissible in courts</td>
</tr>
<tr>
<td>Hybrid/two-tier</td>
<td>Australia, Belgium, Germany</td>
<td>Most nuanced legal system; also most able to capture the complexity of medical and rec. cannabis use</td>
</tr>
</tbody>
</table>

**Source:** Watson, 2016

In alignment with DOT and Occupational medicine conventions. Does not always account for medical patients.
MEDICAL USE AND MVCs: CONFLICTING + FASCINATING RESEARCH

• Some research suggests that policies that legalize cannabis for medical use have been associated with a decrease in the incidence of MVC.

• An ecological study found a net reduction in traffic crashes associated with the introduction of laws for medical cannabis use.

CHEMO- OR IMMUNOPROPHYLAXIS RECOMMENDATIONS

• CBD can negatively modulate the CB1 (THC) receptor via an allosteric mechanism (Laprairie et al., 2015)
  • *Think Antabuse®* (disulfiram)
    • Without the extremely unpleasant reaction

• Cautionary tale
  • Acomplia (rimonabant) = failed management of obesity
  • Selective inhibitor of the CB1 endocannabinoid receptor
  • Management of Obesity

• Therapeutic agents targeting cannabinoid receptors and endocannabinoids are expected to become available in the future

WHAT PREVENTIVE MEDICINE PHYSICIANS MUST KNOW ABOUT DUIC: EVIDENCE-BASED RESPONSES

• NO MIXING
  • Using *alcohol and cannabis together* increases impairment and risk of a motor vehicle crash
    • *more than using either substance alone*
      (Behavioral Health Trends in the United States: Results from the 2014 National Survey on Drug Use and Health, 2015)

• NO ACUTE INTOXICATION TEST
  • DUIC’s are more likely to be detected by distinctive features than by driving faults. (e.g., dilated pupils or an indifferent mood)

• NO CAUSAL RELATIONSHIP
  • A *causal relationship* between cannabis smoking and impaired driving or the risk of accident involvement has not been convincingly *demonstrated* ...yet. (Harthung, 2016)
1º PREVENTION FOR ADULTS: PREVENT INJURY

- ALTER UNSAFE BEHAVIORS
  
  - Legal Consequences/Legislation
    - You can get a DUIC if you use cannabis and drive

  - Public health policies
    - Promote regulations that require packaging for cannabis products to include child-focused safety features (child-resistant packaging)
      - Reduce incidence of accidental cannabis ingestion among pediatric populations

  - Education
    - Do not ride in a car (or allow your child to ride in a car) if the driver is under the influence of cannabis
    - Make a plan with someone you trust to always have a safe ride available
    - **When your teen starts to drive**, let them know that if they use cannabis and drive, **they can get a DUIC** or lose their license.
    - Recent interventions target public awareness, but we can’t yet estimate efficacy (Watson, 2016)
2º PREVENTION FOR ADULTS: REDUCE THE IMPACT

• PROVIDE GUIDANCE

  • EDs nationwide on response to accidental ingestion
    • Pediatric events
    • Cyclic vomiting syndrome

  • If 9-20 year olds have used cannabis, empower them to plan a safe ride home

  • No accurate secondary prevention (screening)
  • There is no field sobriety test
    • This needs to be improved immediately
3º PREVENTION FOR ADULTS: EX POST FACTO

• **BE AN ADVOCATE** for patients with chronic diseases
  - If your patient has a medical cannabis ID card, document this fact in a letter for use in court hearings
  - Much of the published data is on naïve users – not medical patients
  - Field sobriety tests are fraught with issues

• **BE KNOWLEDGEABLE about safety**
  - Be more successful by targeting safety perceptions related to cannabis DUIC rather than knowledge of DUIC laws (Watson, 2016)
  - Discuss workplace issues and cannabis workplace policies
    - 21% of the workforce lives in a state where *recreational use* is legal
    - 62% of the workforce lives in a state where *medical use* of cannabis is legal
  - **Patients must not be impaired at work**
  - **Patients must safely commute to and from work**

• Make a plan to **PREVENT FUTURE DUICS**
  - Recommend 6-8 hrs “wheels up time” – use an airplane metaphor (AFI 11-202v3)
    - Crew members are allowed to commence flight duty with a blood-alcohol level one-quarter of that allowed to motorists.
  - Avoid DUIC’s on patient’s permanent legal record
COMMUNITY-BASED PREVENTIVE RECOMMENDATIONS
Canada's Lower-Risk Cannabis Use Guidelines (LRCUG)

1. Delay using cannabis until adulthood

2. Don't drive or operate heavy machinery under the influence of cannabis
   • Do not drive for at least six hours after smoking
   • Be especially cautious if cannabis and alcohol is combined

3. Don't use synthetic cannabinoids
   • Products such as K2 and Spice should be avoided

4. Avoid cannabis altogether if there is a family history of mental illness
2 WHEEL DRIVE: EFFECTS OF CANNABIS ON A BICYCLE RIDE

- Total prevalence is considered to be 1.9% for the countries of the EU.

- In CO, you can get a DUIC if you use cannabis before riding a bike or scooter (Colorado retail marijuana Report, 2016).

- Yet, no defined THC concentration leads to an inability to ride a bicycle (Hartung, 2016).
  - Subjects showed only slight distinctive features when cycling under the influence of cannabis.
    - Including persons with THC concentrations above 100 ng/ml.

FINAL CONCLUSIONS

1. A causal relationship between cannabis smoking and impaired driving has not been convincingly demonstrated (Harthung, 2016)
   • Yet, National Academy of Sciences notes: “Cannabis use prior to driving increases the risk of being involved in a motor vehicle accident.”

2. THC concentrations and BAC are hard to compare due to the different metabolism pathways

3. Use of single studies or studies that use only one indicator to evaluate the impact of DUIC countermeasures can be misleading (Watson, 2016)
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REFERENCES


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