Implications of High Potency Cannabis for Employers

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Learning Objectives

- Appreciate the medical effects of High potency cannabis.
- Evaluate for acute cannabis use versus chronic use, clinical signs and symptoms and interpreting lab results. Impairment versus use.
- State the concerns for employers with regards to employee cannabis use, both acute and chronic use risk factors.

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Changing Medico-Legal Environment

- 38 States, the District of Columbia, and 5 US territories have legalized Medical Marijuana.
- 24 States, the District of Columbia, and 3 U.S. territories have legalized recreational use of Marijuana.

https://norml.org/laws - State by State review by Author

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Changing Medico-Legal Environment

- Risks to employers/businesses
- Loss of potential employees, particularly if operating under a Drug Free Workplace Policy.
- Risk of injuries, accidents from impairment.
- Risk of absenteeism, or worse presenteeism.
- Risk of motor vehicle accidents.
- Need for cannabis specific policies.
- Need for Medical Review Officer involvement.

Phillips, JA. Marijuana in the Workplace: Guidance for Occupational Health Professionals and Employers: Joint Guidance Statement

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Risks to Employers

- Exposure to litigation
  - As the laws change, there will be more retaliatory litigation towards employers who terminate employees for cannabis use off duty, but still test positive on metabolite-based testing.
  - Currently several states provide protections, but State Supreme Court rulings have differed State to State.
    - For example, in **Coates v. Dish Network**, the Colorado Supreme Court judged that a paraplegic with a medical marijuana certification who was terminated for a positive cannabis metabolite testing who sued for wrongful termination, the Court sided with Dish network.
    - In contrast, in **Scranton Quincy Clinic Company, LLC v. Palmiter**, a medical assistant who uses medical marijuana to treat chronic pain, chronic migraines, and persistent fatigue, was advised that she could not continue to work after failing a drug test, despite providing a copy of her medical marijuana certification. Although the MMA does not create an express private right of action, the medical assistant brought a claim for discrimination and wrongful discharge in violation of the law and won.

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Cannabis use Statistics

- 43% of Americans have tried marijuana at least once.
- In 2022, marijuana was the most commonly used illicit drug, with 22.0% of people aged 12 or older (or 61.9 million people) using it in the past year.
- The percentage was highest among young adults aged **18 to 25** (38.2% or 13.3 million people), followed by **adults aged 26 or older** (20.6% or 45.7 million people), then by adolescents aged 12 to 17 (11.5% or 2.9 million people).

2022 NSDUH, SAMHSA

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Marijuana Use Disorder Statistics

- Of the 61.9 million people aged 12 or older who used marijuana in the past year:
- 19.0 million people had a marijuana use disorder.
- **Most (55.1 percent) had a mild disorder** compared with only 17.3 percent who had a severe disorder.
- **About 1 out of 100 people will have a severe Marijuana Use Disorder in the general population of the US.**

2022 NSDUH: SAMHSA

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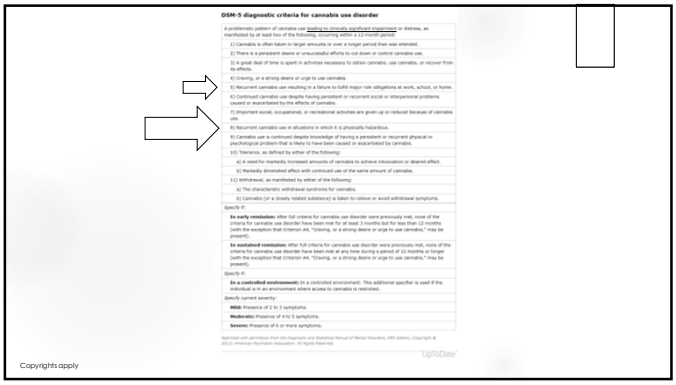

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Cannabis Potency Over time

- 1970's – THC Concentration = <2%
- 1980's – THC Concentration = 2-3%
- 1990's – THC Concentration = 3-5%
- 2000's – THC Concentration = 5-10%
- 2010's – THC Concentration = 10-17%

- Sinsemilla – "without seed" – unfertilized female cannabis plants are specifically grown and harvested to further increase the THC concentrations up to around 30% THC.
- Concentrates – "wax, Butane Hash Oil, dabbing" indicate further artificial concentrating techniques that can reach concentrations >90% THC.

Source: Potency Monitoring Program, Quarterly Report # 153, NIDA Contract Number: NO1DA-15793

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Cannabis Effects

- Cannabis has broad ranging effects.
  - Cardiovascular – Most acute risk factors
    - Myocardial infarction or Coronary Artery Disease
    - Cerebrovascular Accident
      - Among US adults ages 18-74 years, when compared with nonusers, frequent marijuana use was associated with **88% higher odds of myocardial infarction** or coronary artery disease (adjusted odds ratio [aOR] 1.88; 95% confidence interval [CI], 1.15-3.08), and **81% higher odds of stroke**.
    - Arrhythmia
      - People diagnosed with Cannabis Use Disorder are associated with a 47%-52% increased likelihood of arrhythmia hospitalization.
      - Most common arrhythmias were atrial fibrillation (42%) and atrial flutter (8%).

1. Shah S, et al. Association of Marijuana Use and Cardiovascular Disease: A Behavioral Risk Factor Surveillance System Data Analysis of 133,706 US Adults. Am J Med.
2. Patel RS, et al. Cannabis use disorder and increasedrisk of arrhythmia-related hospitalization in young adults. Am J Addict.

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Cannabis Medical Adverse Effects

- Cannabis has broad ranging adverse effects.
  - Pulmonary
    - Acute irritation of lung function
      - A meta-analysis provided some evidence at marijuana smoke is associated with:
        - Cough
        - Sputum production
        - Wheezing
    - Concentrates exacerbate this further
      - E-cigarette, or vaping, product use-associated lung injury (EVALI)
      - Associated with contamination of Vitamin E acetate

1. Ghasemiesfe M, Marijuana Use, Respiratory Symptoms, and Pulmonary Function: A Systematic Review and Meta-analysis.
2. Stefaniak AB. Ann Intern Med. Toxicology of flavoring- and cannabis-containing e-liquids used in electronic delivery systems.

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Cannabis Effects

- Cannabis has broad ranging effects.
  - Cannabinoid Hyperemesis Syndrome (CHS)
    - Defined as episodic severe nausea and vomiting and abdominal pain associated with heavy or chronic cannabis use and which is often relieved by exposure to hot water via shower or bath.
    - Usually resolves after the patient has been abstinent from cannabis for 1-2 days.
    - Using benzodiazepines in the ER can be effective to stop the emesis as well.

Galenianpr M, et al. Cannabinoid hyperemesis syndrome: definition, pathophysiology, clinical spectrum, insights into cause and long-term management. J Investig Med.

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Cannabis Effects

- Cannabis has broad ranging effects.
  - Reproductive effects
    - Reduced Sperm Count
      - Regular marijuana smoking more than once per week was associated with a 28% (95% confidence interval (CI): -48, -1) lower sperm concentration and a 29% (95% CI: -46, -1) lower total sperm count after adjustment for confounders.
    - Neonatal outcomes of mothers using cannabis
      - **Greater odds of**:
      - **Preterm birth** (adjusted odds ratio [aOR], 1.42; 95% confidence interval [CI], 1.19 to 1.69; I2, 93%; p=0.0001),
      - **Small for gestational age** (aOR, 1.76; 95% CI, 1.52 to 2.05; I2, 86%; p<0.0001)
      - **Perinatal mortality** (aOR, 1.5; 95% CI, 1.39 to 1.62; I2, 0%; p<0.0001),

1. Gunderson TD, et al. Association Between Use of Marijuana and Male Reproductive Hormones and Semen Quality: A Study Among 1,215 Healthy Young Men. Am J Epidemiol.
2. Lo JO, Shaw B, et al. Cannabis Use in Pregnancy and Neonatal Outcomes: A Systematic Review and Meta-Analysis. Cannabis Cannabinoid Res.

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Cannabis Effects

- Cannabis has broad ranging effects.
  - Ophthalmologic
    - Conjunctival injection
    - Transient decreased intraocular pressure
    - Nystagmus
    - Hallucinations
    - Reduced tear production

Peragallo J, et al. Ocular manifestations of drug and alcohol abuse. Curr Opin Ophthalmol.

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Acute Cannabis Intoxication

- Clinical Picture - Physiological
  - Red eyes
  - Nystagmus
  - Ataxia
  - Slurred speech
  - Dry mouth
  - Increased appetite
  - Tachycardia
  - Increased blood pressure
  - Increased respiratory rate

Grotenhermen F. Pharmacokinetics and pharmacodynamics of cannabinoids. Clin Pharmacokinet.

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Acute Cannabis Intoxication

- Clinical Picture – Psychiatric
  - Abnormal range of mood from euphoric to dysphoric
  - Abnormal range of anxiety from decreased to panic levels
  - Disorganized thought process
  - Hallucinations
  - Paranoia
  - Delusions
  - Depersonalization
  - These generally are worsened with exposure to high potency cannabinoids.

Hindley G, et al. Psychotic symptoms caused by cannabis and K2 in humans: a systematic review and meta-analysis. Lancet Psychiatry.

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Chronic Cannabis User

- Long term Chronic users develop tolerance to the acute effects of cannabis
- Thus, you may not see:
  - Injected conjunctiva
  - Ataxia
  - Slurred speech
  - Nystagmus
- This is similar to heavy alcohol users, as tolerance develops the more acute signs of intoxication reduce.
- This does NOT equate to lack of impairment due to acute use.

Phillips JA, et al. Marijuana in the Workplace: Guidance for Occupational Health Professionals and Employers: Joint Guidance Statement of the American Association of Occupational Health Nurses and the American College of Occupational and Environmental Medicine. Workplace Health Saf.

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Cannabis Impairment Effects

- Neurologic
  - Psychomotor impairment emerges immediately after acute cannabis use even in regular users but decreases significantly 1-hour post use.
  - The domains of impairment were
    - Impaired balance function
    - Increased body sway
    - Reduced proprioception or postural tracking.
    - Slower response times
      - Increased simple reaction time
      - Reduced selective attention
      - Reduced sustain attention
      - Reduced divided attention
    - Reduced reaction speed in driving simulations

Karoly HC, et al. Effects of High-Potency Cannabis on Psychomotor Performance in Frequent Cannabis Users. Cannabis Cannabinoid Res.

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Cannabis Impairment Effects

- High Potency Cannabis effects (>90% THC) in frequent users
  - Arm Extension Task
    - Slowed by 15% at both immediately post use, and 1 hour later.
  - Leg Withdrawal Task
    - Slowed by 6%-7% at both immediately post use, and 1 hour later.
  - Postural Sway
    - With Eyes open
      - Slowed by 4% acutely but recovered by 1 hour post use.
    - With eyes closed
      - Slowed by 7% acutely but recovered by 1 hour post use.

Hitchcock LN, et al. Acute Effects of Cannabis Concentrate on Motor Control and Speed: Smartphone-Based Mobile Assessment. Front Psychiatry.

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Cannabis Impairment Effects

When using concentrates, blood levels were double that of flower users

-However, users titrated their use to achieve similar blood levels to effect.

-Thus, the same levels of intoxication were achieved by the users.

-Delayed Verbal recall performance was impaired after use. Impaired Memory.

-Heavy users of cannabis were resistant to many of the impairment effects that are observable amongst naïve users

-The exception was with the degree of balance impairment

-Balance impairment was approximately 11% worse than baseline.

-This is consistent with a Blood Alcohol Level of 0.05% to 0.10% BAC

This was present even in frequent users and could be a valuable sign of acute use/impairment.

Bidwell LC, et al. Association of Naturalistic Administration of Cannabis Flower and Concentrates With Intoxication and Impairment. JAMA Psychiatry.

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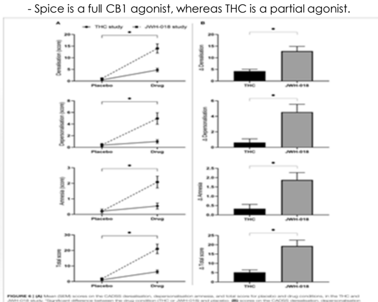
Cannabis Impairment Effects

This study compared natural cannabis vs synthetic CB1 Agonist JWH-018 (SPICE)

- Spice is a full CB1 agonist, whereas THC is a partial agonist.



Theunissen EL, et al. A Comparison of Acute Neurocognitive and Psychotomimetic Effects of a Synthetic Cannabinoid and Natural Cannabis at Psychotropic Dose Equivalence. Front Psychiatry.

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Testing for Cannabis Use

- Generally accepted testing is via Urine Immunoassay
  - Looking for 11-Nor-9-carboxy-Δ9-tetrahydrocannabinol (11-COOH-THC or THC-COOH)
  - Detection via urine typically will turn positive 2-5 hours post consumption.
  - Highly variable how long this metabolite will remain positive based on the chronicity of cannabis use.
  - From days in an infrequent user to up to 120 days in a heavy user.

Westin AA. Cannabis og urinprøver [Cannabis and urine samples]. Tidsskr Nor Laegeforen. 2011 Mar

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Testing for Cannabis - Workplace

- When considering the occupational harms of high potency cannabis:
  - **Impairment** is of chief concern.
  - The impairment associated with cannabis use is precipitated by Neurological and Cognitive changes.
  - Impairment from marijuana varies with THC concentration or dose, route of administration, and users' experience with, or tolerance to, the drug.

Phillips JA, et al. Marijuana in the Workplace: Guidance for Occupational Health Professionals and Employers: Joint Guidance Statement of the American Association of Occupational Health Nurses and the American College of Occupational and Environmental Medicine. Workplace Health Saf.

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Testing for Cannabis Use - Workplace

- Presence of marijuana metabolite does not equate to impairment, as the positivity of metabolite testing can remain positive long after the acute intoxication phase ends.
- In post workplace injuries when employees test positive for cannabis, there are severe implications.
- For example: an employer **may need both the presence of a positive metabolite test and objective proof of intoxication/impairment** at time of injury to deny compensation benefits.

Phillips JA, et al. Marijuana in the Workplace: Guidance for Occupational Health Professionals and Employers: Joint Guidance Statement of the American Association of Occupational Health Nurses and the American College of Occupational and Environmental Medicine. Workplace Health Saf.

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Testing for Cannabis Use & impairment

- Serum testing can also be utilized to determine a likely impaired state.
- Serum levels of an average of 3.8 ng/mL (3.1 to 4.5) for oral and 3.8 ng/mL (3.3 to 4.5) for smoked marijuana cause impairment approximately equivalent to a BAC of around 0.05 g%.
- **A plasma level of 5 ng/mL of THC** can be used as one indicator with other medical signs of **acute impairment from marijuana**.

Phillips JA, et al. Marijuana in the Workplace: Guidance for Occupational Health Professionals and Employers: Joint Guidance Statement of the American Association of Occupational Health Nurses and the American College of Occupational and Environmental Medicine. Workplace Health Saf.

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Testing for Cannabis Use

Table 1. Establishing Impairment—Casual vs Long-term User

THC Plasma Level	Casual User	Long-term User
0–2 ng/mL	Cannot establish impairment	Cannot establish impairment
2–5 ng/mL	Likely impaired	May be impaired
5+ng/mL	Likely impaired	Likely impaired

THC, delta-9-tetrahydrocannabinol.

Phillips JA, et al. Marijuana in the Workplace: Guidance for Occupational Health Professionals and Employers: Joint Guidance Statement of the American Association of Occupational Health Nurses and the American College of Occupational and Environmental Medicine. Workplace Health Saf.

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Implications for employers

- Employers who decide to or are required to accept employees' use of medical and/or recreational marijuana consistent with state law **must carefully assess risk of impairment from marijuana use, especially for those employees in safety-sensitive positions.**

Phillips JA, et al. Marijuana in the Workplace: Guidance for Occupational Health Professionals and Employers: Joint Guidance Statement of the American Association of Occupational Health Nurses and the American College of Occupational and Environmental Medicine. Workplace Health Saf.

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Implications for employers

- A medical review officer (MRO) and other occupational health professionals should be included, with legal counsel, in discussions about company policy or individual use of marijuana.
- Specific guidelines regarding testing for postaccident and possible impairment assessments should be developed and explained to employees.
  - **Serum testing is recommended if available.**
  - **Proof of use AND impairment are needed to deny claims.**

Phillips JA, et al. Marijuana in the Workplace: Guidance for Occupational Health Professionals and Employers: Joint Guidance Statement of the American Association of Occupational Health Nurses and the American College of Occupational and Environmental Medicine. Workplace Health Saf.

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Implications for employers

- The occupational health professional responsible for providing a medical evaluation of employees' fitness for duty should establish and consistently apply clear guidelines on the situations for which use of medical marijuana would be considered. It is advisable for medical evaluations to include:
  - documentation of state registration for medical marijuana
  - the schedule of use relative to working hours
  - cannabis form used (eg, smoked plant material, edibles, vs concentrates)
  - the need for any accommodations given the employees' job duties
  - anticipated duration of use.

Phillips JA, et al. Marijuana in the Workplace: Guidance for Occupational Health Professionals and Employers: Joint Guidance Statement of the American Association of Occupational Health Nurses and the American College of Occupational and Environmental Medicine. Workplace Health Saf.

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Implications for employers

- The occupational health provider should work with site management to assess risk based on the safety-sensitive nature of the job.
- Considerations of workplace safety in the context of the underlying medical condition for which marijuana has been recommended may also be appropriate.

Phillips JA, et al. Marijuana in the Workplace: Guidance for Occupational Health Professionals and Employers: Joint Guidance Statement of the American Association of Occupational Health Nurses and the American College of Occupational and Environmental Medicine. Workplace Health Saf.

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Implications for employers

- Development of policies pertaining to marijuana are needed
  - purpose/intent of the program
  - employees covered by the policy
    - Medical Marijuana vs Recreational Marijuana
  - when the policy applies (off duty use prohibited or not)
  - prohibited behavior
  - whether employees are required to inform their supervisor of medical marijuana prescription or drug related convictions
  - whether the policy covers searches and extent of the search allowed
  - observable and measurable behaviors indicative of unsafe job performance

Phillips JA, et al. Marijuana in the Workplace: Guidance for Occupational Health Professionals and Employers: Joint Guidance Statement of the American Association of Occupational Health Nurses and the American College of Occupational and Environmental Medicine. Workplace Health Saf.

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Implications for employers

- Development of policies pertaining to marijuana are needed
  - referral mechanism for unsafe work performance
  - requirements for drug testing with input from the MRO
  - consequences for policy violation
  - whether return-to-work agreements are needed after an absence related to substance abuse
  - measures to protect employee confidentiality
  - measures for policy enforcement
  - steps to communicate policy to employees, supervisors, occupational health professionals, management, union management when applicable, and contractors and their employees
  - Whether assistance is available to treat substance use or abuse.

Phillips JA, et al. Marijuana in the Workplace: Guidance for Occupational Health Professionals and Employers: Joint Guidance Statement of the American Association of Occupational Health Nurses and the American College of Occupational and Environmental Medicine. Workplace Health Saf.

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Implications for employers

- Development of policies pertaining to marijuana are needed
  - Employers **should consult with legal counsel** when developing policies regarding employee use of medical marijuana.

Phillips JA, et al. Marijuana in the Workplace: Guidance for Occupational Health Professionals and Employers: Joint Guidance Statement of the American Association of Occupational Health Nurses and the American College of Occupational and Environmental Medicine. Workplace Health Saf.

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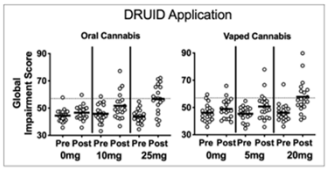
Innovations in impairment testing

- Smartphone based impairment testing is emerging.



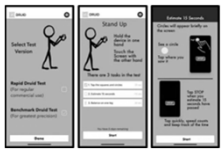


Figure 2. Performance on the DRUID® (i.e. global impairment scores) for each individual participant at baseline and post-cannabis administration (i.e. raw peak scores) in each experimental condition. Higher scores indicate worse performance (i.e. greater impairment). The dotted line (i.e. score of 57) signifies the threshold used to classify participants as "impaired"; this threshold was associated with a blood-alcohol concentration of 0.08% in a prior controlled alcohol dosing study (Richman and Hay, 2019). Peak scores were calculated for each respective route of administration within time frames previously shown to coincide with peak drug effects (i.e. 0–2 h for vaporized conditions and 2–5 h for oral conditions).

Spindle TR, et al. Assessment of cognitive and psychomotor impairment, subjective effects, and blood THC concentrations following acute administration of oral and vaporized cannabis. J Psychopharmacol.

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Conclusions

- The effects of High potency cannabis medically in naïve users are quite impairing, however, **in chronic users their tolerance will mask most acute symptoms of intoxication.**
- Blood Serum levels of THC have more correlation to acute impairment than the presence of the metabolite in urine assays.
- The **serum level of more than 5 ng/mL** are indicative of impairment in both naïve and chronic users of cannabis.
- Employers in States where cannabis use is medicalized or legalized should strongly consider consulting with an **MRO and legal counsel** in development of cannabis related policies.

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Bibliography

- 2022 National Survey on Drug Use and Health. SAMHSA. 2022 National Survey on Drug Use and Health (NSDUH) Releases (samhsa.gov)
- Karoly HC, Milburn M A, Brooks-Russell A, Brown M, Streufert J, Bryan AD, Lovrich NP, DeJong W, Cinnamon Bidwell L. Effects of High-Potency Cannabis on Psychomotor Performance in Frequent Cannabis Users. Cannabis Cannabinoid Res. 2022 Feb;7(1):107-115. doi: 10.1089/can.2020.0048. Epub 2020 Sep 10. PMID: 33998859; PMCID: PMC8864436.
- Hitchcock LN, Tracy BL, Bryan AD, Hutchison KE, Bidwell LC. Acute Effects of Cannabis Concentrate on Motor Control and Speed: Smartphone-Based Mobile Assessment. Front Psychiatry. 2021 Jan 22;11:623672. doi: 10.3389/fpsyt.2020.623672. PMID: 33551884; PMCID: PMC7862106.
- Bidwell LC, Ellingson JM, Karoly HC, YorkWilliams SL, Hitchcock LN, Tracy BL, Klawitter J, Sempio C, Bryan AD, Hutchison KE. Association of Naturalistic Administration of Cannabis Flower and Concentrates With Intoxication and Impairment. JAMA Psychiatry. 2020 Aug 1;77(8):787-796. doi: 10.1001/jamapsychiatry.2020.0927. PMID: 32320016; PMCID: PMC7287943.
- https://blogs.cdc.gov/niosh-science-blog/2020/04/15/cannabis-and-work/
- Cuttler C, LaFrance EM, Stueber A. Acute effects of high-potency cannabis flower and cannabis concentrates on everyday life memory and decision making. Sci Rep. 2021 Jul 2;11(1):13784. doi: 10.1038/s41598-021-93198-5. PMID: 34215784; PMCID: PMC8253757.
- Carnide N, Landsman V, Lee H, Frone MR, Furlan AD, Smith PM. Workplace and non-workplace cannabis use and the risk of workplace injury: Findings from a longitudinal study of Canadian workers. Can J Public Health. 2023 Dec;114(6):947-955. doi: 10.17269/s41997-023-00795-0. Epub 2023 Jul 31. PMID: 37523062; PMCID: PMC10661545.
- NIDA Potency Monitoring Program, Quarterly Report # 153, NIDA Contract Number: N01DA-15-7793
- Phillips JA, Holland MG, Baldwin DD, Gifford-Meuleveld L, Mueller KL, Perkison B, Upfal M, Dreger M. Marijuana in the Workplace: Guidance for Occupational Health Professionals and Employers: Joint Guidance Statement of the American Association of Occupational Health Nurses and the American College of Occupational and Environmental Medicine. Workplace Health Saf. 2015 Apr;63(4):139-64. doi: 10.1177/2165079915581983. Epub 2015 Apr 10. PMID: 25862727.
- Theunissen EL, Kuypers KPC, Mason NL, Ramaekers JG. A Comparison of Acute Neurocognitive and Psychotomimetic Effects of a Synthetic Cannabinoid and Natural Cannabis at Psychotropic Dose Equivalence. Front Psychiatry. 2022 May 19;13:893811. doi: 10.3389/fpsyt.2022.893811. PMID: 35664482; PMCID: PMC9160432.

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Bibliography

- Ghasemiesfe M, Ravi D, Vali M, Korenstein D, Arjomandi M, Frank J, Austin PC, Keyhani S. Marijuana Use, Respiratory Symptoms, and Pulmonary Function: A Systematic Review and Meta-analysis. Ann Intern Med. 2018 Jul 17;169(2):106-115. doi: 10.7326/M18-0522. Epub 2018 Jul 3. PMID: 29971337; PMCID: PMC6231497.
- Stefaniak AB, LeBouf RF, Ranpara AC, Leonard SS. Toxicology of flavoring- and cannabis-containing e-liquids used in electronic delivery systems. Pharmacol Ther. 2021 Aug;224:107838. doi: 10.1016/j.pharmthera.2021.107838. Epub 2021 Mar 18. PMID: 33746051; PMCID: PMC8251682.
- Shah S, Patel S, Paulraj S, Chaudhuri D. Association of Marijuana Use and Cardiovascular Disease: A Behavioral Risk Factor Surveillance System Data Analysis of 133,706 US Adults. Am J Med. 2021 May;134(5):614-620.e1. doi: 10.1016/j.amjmed.2020.10.019. Epub 2020 Nov 9. PMID: 33181103.
- Patel RS, Gonzalez MD, Ajibawo T, Baweja R. Cannabis use disorder and increased risk of arrhythmia-related hospitalization in young adults. Am J Addict. 2021 Nov;30(6):578-584. doi: 10.1111/ajad.13215. Epub 2021 Aug 25. PMID: 34432919.
- Gajendran M, Sifuentes J, Bashashati M, McCallum R. Cannabinoid hyperemesis syndrome: definition, pathophysiology, clinical spectrum, insights into acute and long-term management. J Investig Med. 2020 Dec;68(8):1309-1316. doi: 10.1136/jim-2020-001564. Epub 2020 Oct 28. PMID: 33115959.
- Gundersen TD, Jørgensen N, Andersson AM, Bang AK, Nordkap L, Skakkebæk NE, Priskorn L, Juul A, Jensen TK. Association Between Use of Marijuana and Male Reproductive Hormones and Semen Quality: A Study Among 1,215 Healthy Young Men. Am J Epidemiol. 2015 Sep 15;182(6):473-81. doi: 10.1093/aje/kwv135. Epub 2015 Aug 16. PMID: 26283092.
- Lo JO, Shaw B, Robalino S, Ayers CK, Durbin S, Rushkin MC, Olyaei A, Kansagara D, Harrod CS. Cannabis Use in Pregnancy and Neonatal Outcomes: A Systematic Review and Meta-Analysis. Cannabis Cannabinoid Res. 2023 Feb 1. doi: 10.1089/can.2022.0262. Epub ahead of print. PMID: 36730710.
- Peragallo J, Biousse V, Newman NJ. Ocular manifestations of drug and alcohol abuse. Curr Opin Ophthalmol. 2013 Nov;24(6):566-73. doi: 10.1097/ICU.0b013e3283654db2. PMID: 24100364; PMCID: PMC4545665.
- Hindley G, Beck K, Borgan F, Ginestet CE, McCutcheon R, Kleinloog D, Ganesh S, Radhakrishnan R, D'Souza DC, Howes OD. Psychiatric symptoms caused by cannabis constituents: a systematic review and meta-analysis. Lancet Psychiatry. 2020 Apr;7(4):344-353. doi: 10.1016/S2215-0366(20)30074-2. Epub 2020 Mar 17. PMID: 32197092; PMCID: PMC7738353.
- Grotenhermen F. Pharmacokinetics and pharmacodynamics of cannabinoids. Clin Pharmacokinet. 2003;42(4):327-60. doi: 10.2165/00003088-200342040-00003. PMID: 12648025.
- Westin AA. Cannabis og urinprøver [Cannabis and urine samples]. Tidsskr Nor Laegeforen. 2011 Mar 18;131(6):577-80. Norwegian. doi: 10.4045/tidsskr.09.1111. PMID: 21423309.
- Spindle TR, Martin EL, Grabenauer M, Woodward T, Milburn MA, Vandrey R. Assessment of cognitive and psychomotor impairment, subjective effects, and blood THC concentrations following acute administration of oral and vaporized cannabis. J Psychopharmacol. 2021 Jul;35(7):786-803. doi: 10.1177/02698811211021583. Epub 2021 May 28. PMID: 34049452; PMCID: PMC9361180.

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Testing questions

- Clinical presentation of chronic versus acute cannabis users show what primary difference?
  - Chronic users do not show as many acute symptoms of cannabis ingestion due to tolerance development.
- What is the most consistent lab testing method to demonstrate impairment due to cannabis?
  - Serum THC levels of greater than 5 ng/nL.
- What are the two most important consultants for employers developing cannabis policies?
  - Medical Resource Officer and Legal counsel.

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