



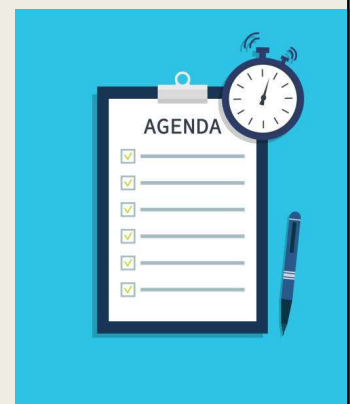
HIGH SOCIETY: CANNABIS IN THE WORKPLACE

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UI Occupational Health
christopher-iverson@uiowa.edu

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Overview

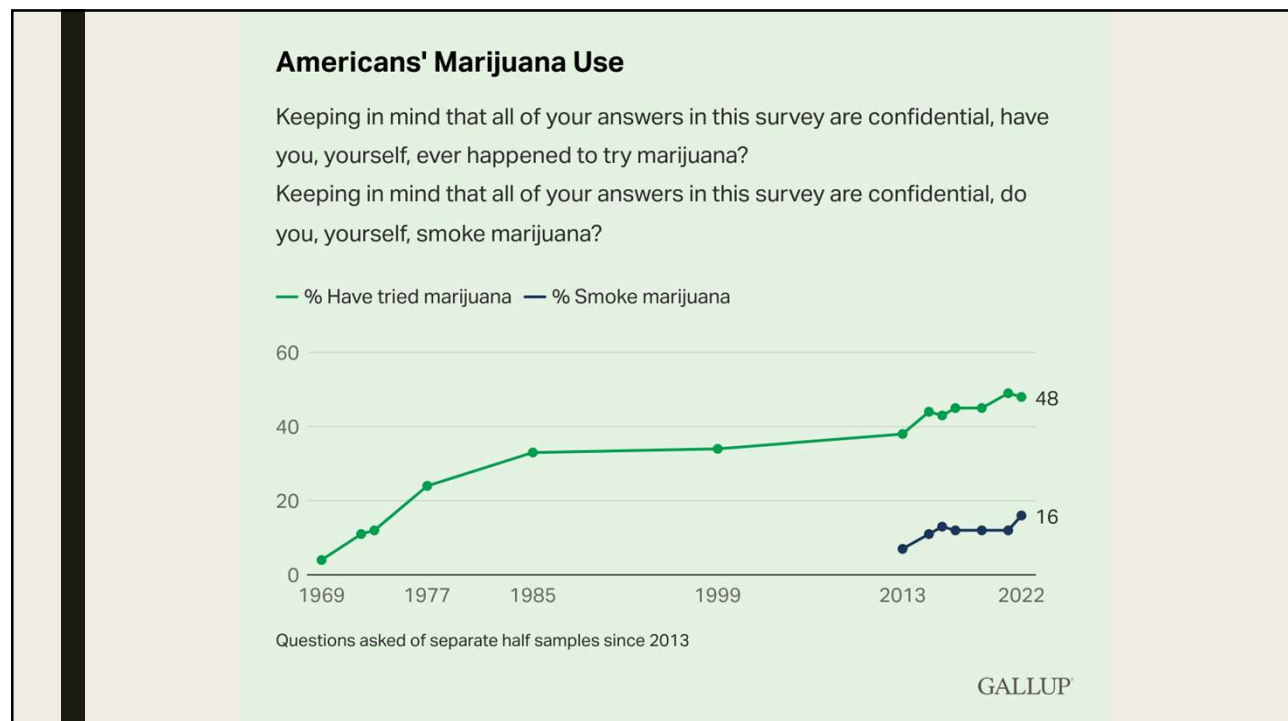
- Changing landscape
- Cannabis
- Drug testing for cannabis
- Impairment



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CHANGING LANDSCAPE

3



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Americans' Marijuana Use

	Ever tried marijuana	Smoke marijuana	Consume marijuana edibles
	%	%	%
U.S. adults	48	16	14
Gender			
Men	53	18	14
Women	42	14	13
Age			
18 to 34	51	30	22
35 to 54	49	16	16
55+	44	7	7
Education			
College graduate	47	12	16
Some college	44	22	12
No college	52	16	14
Party ID			
Democrats	53	20	17
Independents	55	17	17
Republicans	34	12	9

JULY 5-26, 2022

GALLUP

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Perceived Effect of Marijuana Use, by Experience With Marijuana

What effect do you think the use of marijuana has on [most people who use it/society]?

■ % Very/Somewhat positive ■ % Very/Somewhat negative

Effect on most marijuana users



Effect on society



Those with no opinion are not shown.

JULY 5-26, 2022

GALLUP

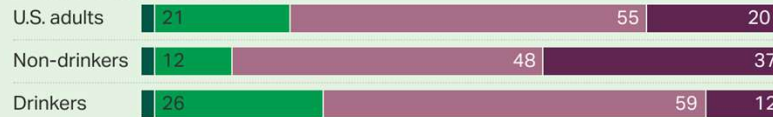
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Perceived Effect of Alcohol Use, by Subgroup

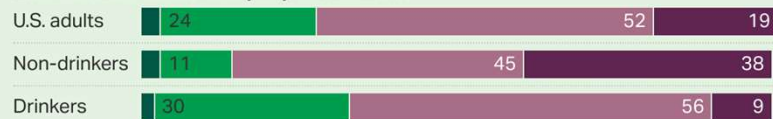
What effect do you think the use of alcohol has on [society/most people who drink]?

■ % Very positive ■ % Somewhat positive ■ % Somewhat negative ■ % Very negative

Effect of alcohol on society



Effect of alcohol on most people who drink



Those with no opinion are not shown.

JULY 5-26, 2022

GALLUP

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Perceived Effect of Marijuana Use, by Experience With Marijuana

What effect do you think the use of marijuana has on [most people who use it/society]?

■ % Very/Somewhat positive ■ % Very/Somewhat negative

Effect on most marijuana users



Effect on society



Those with no opinion are not shown.

JULY 5-26, 2022

GALLUP

Perceived Effect of Alcohol Use, by Subgroup

What effect do you think the use of alcohol has on [society/most people who drink]?

■ % Very positive ■ % Somewhat positive ■ % Somewhat negative ■ % Very negative

Effect of alcohol on society



Effect of alcohol on most people who drink

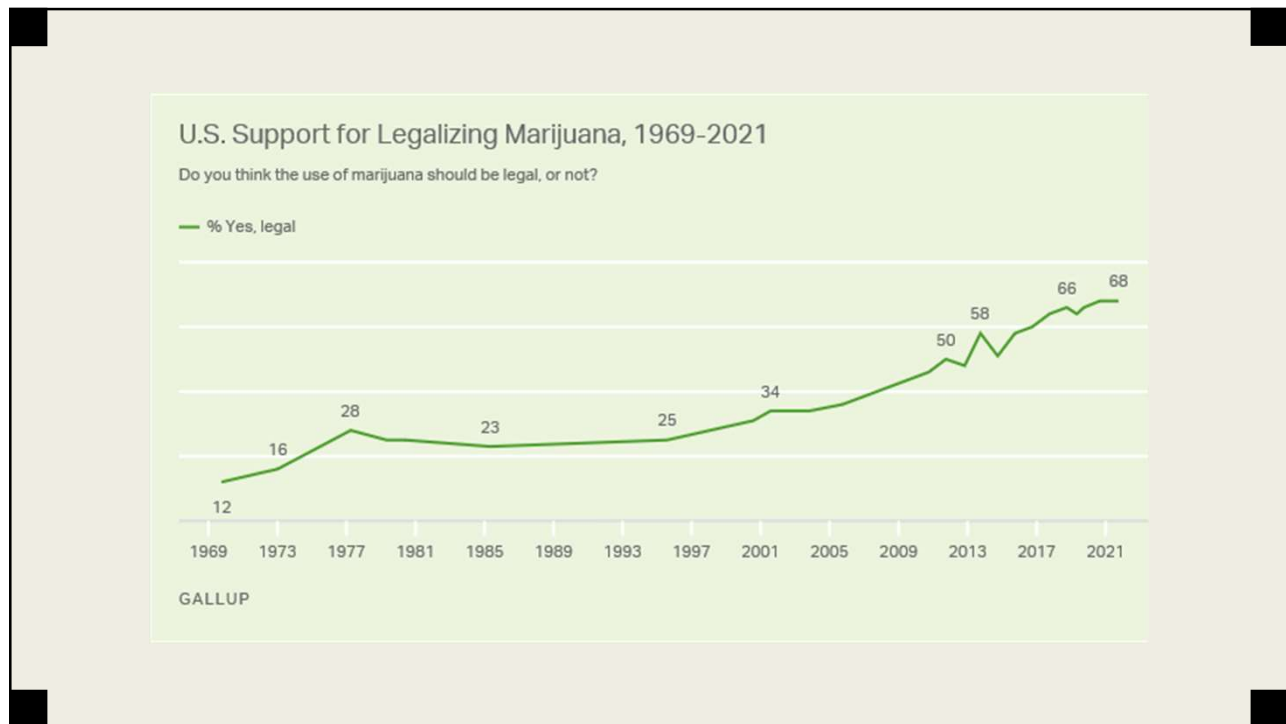


Those with no opinion are not shown.

JULY 5-26, 2022

GALLUP

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Qualifying Conditions

An Iowa resident may qualify for Iowa's Medical Cannabidiol Program if their Healthcare Practitioner certifies they have one of the following Qualifying Debilitating Medical Conditions:

- Cancer – if the illness or its treatment produces one or more of the following: severe or chronic pain, nausea or severe vomiting, cachexia or severe wasting.
- Seizures
- Crohn's disease
- Chronic pain
- Multiple Sclerosis with severe and persistent muscle spasms
- AIDS or HIV (as defined in Iowa Code, section 141A.1)
- Amyotrophic lateral sclerosis (ALS)
- Parkinson's disease
- Post-Traumatic Stress Disorder (PTSD)
- Any terminal illness with a probable life expectancy of under one year – if the illness or its treatment produces one or more of the following: severe or chronic pain, nausea or severe vomiting, cachexia or severe wasting
- Ulcerative colitis
- Severe, intractable *pediatric* autism with self-injurious or aggressive behaviors
- Severe, intractable autism with self-injurious or aggressive behaviors
- Corticobasal Degeneration

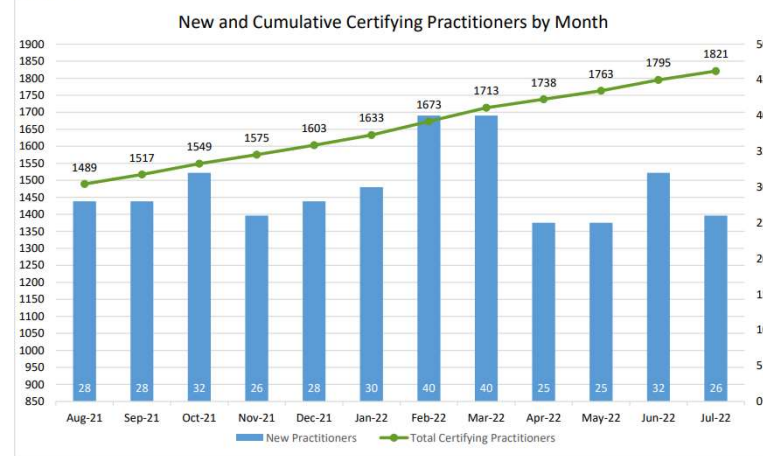
10

Healthcare Practitioners

A Healthcare Practitioner is defined as a physician (MD/DO), physician assistant (PA), advanced registered nurse practitioner (ARNP), or a podiatrist (DPM).

Figure 1 depicts the number of healthcare practitioners (HCPs) in a month who have certified their first unique patient, as well as the cumulative number of HCPs who have certified at least one patient since the beginning of the program.

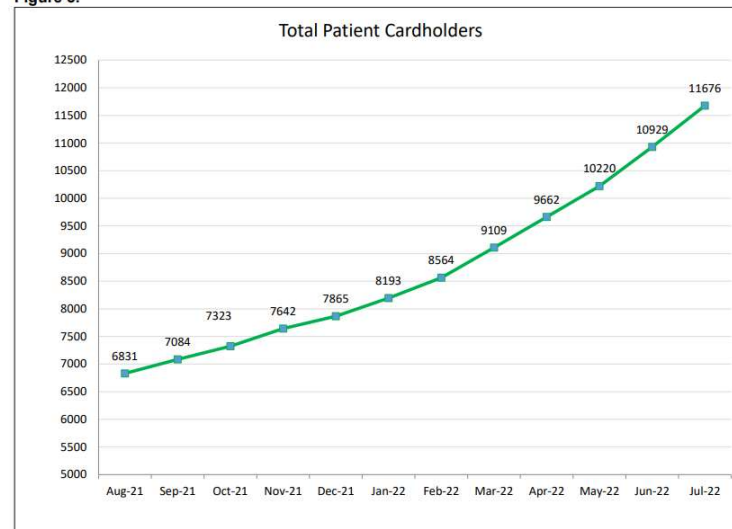
Figure 1.



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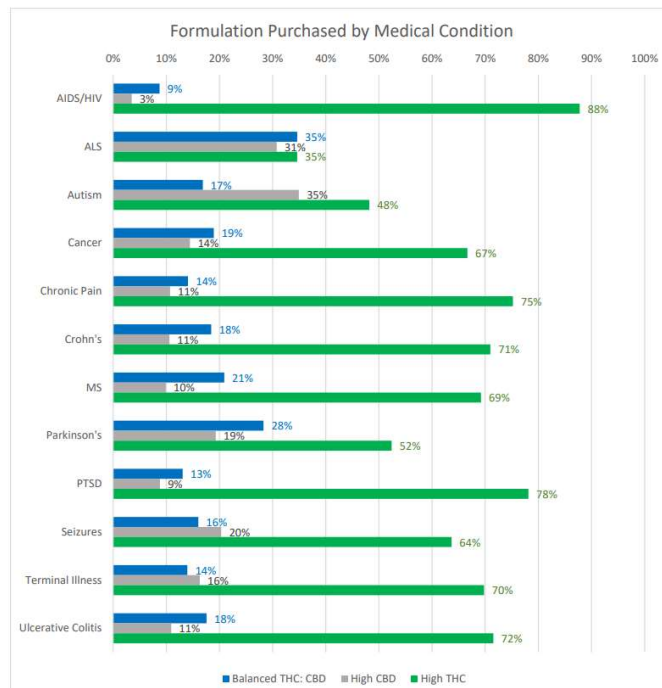
Figure 3 depicts the number of patients with *active* registration cards in each of the last 12 months. The total includes adult and minor patients. Prior to July 1, 2020 registration cards were issued by the Iowa Department of Transportation. IDPH began issuing cards on July 1, 2020.

Figure 3.



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Figure 16.



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CANNABIS

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Origins

- Two strains most common
 - *Cannabis sativa*
 - *Cannabis indica*
- Marijuana and hemp both derive from the cannabis plant



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HEMP vs MARIJUANA

HEMP AND MARIJUANA BOTH DERIVE FROM THE CANNABIS SATIVA FAMILY, THEY DO SHARE CERTAIN SIMILARITIES, HOWEVER, DUE TO EACH PLANT'S BIOLOGICAL STRUCTURE, THEY HAVE SEVERAL VERY DISTINCT AND CRUCIAL DIFFERENCES.



HEMP

Product

- CBD oil
- Hemp oil
- Cannabis oil (made from hemp)

Contains

- 0.3 % or less of tetrahydrocannabinol (THC)

Characteristic

- Hemp and industry hemp refer to the strain of cannabis plant that is grown for agricultural products such as textiles, seeds and oils.
- Can grow as high as 20 feet with leaves bunched near the top of stem.
- No psychoactive properties
- Can grow in most climates, bunched together with other plants, requires little care.



MARIJUANA

Product

- THC oil
- Marijuana oil
- Cannabis oil (made from marijuana)

Contains

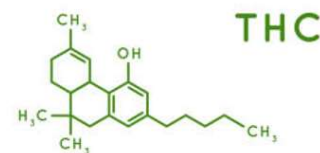
- 15 - 20 % of tetrahydrocannabinol (THC)

Characteristic

- Marijuana is known for its flowering tops of the plant. The flowers are typically bared to have a high THC.
- Growth is carefully monitored, controlled in an isolated, warm, humid area to maximize psychoactive uses. Cross-pollination can ruin THC content.
- Shorter, resembles a bush, with more leaves and buds surrounding the plant's body
- Psychoactive side effects.

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Cannabinoids

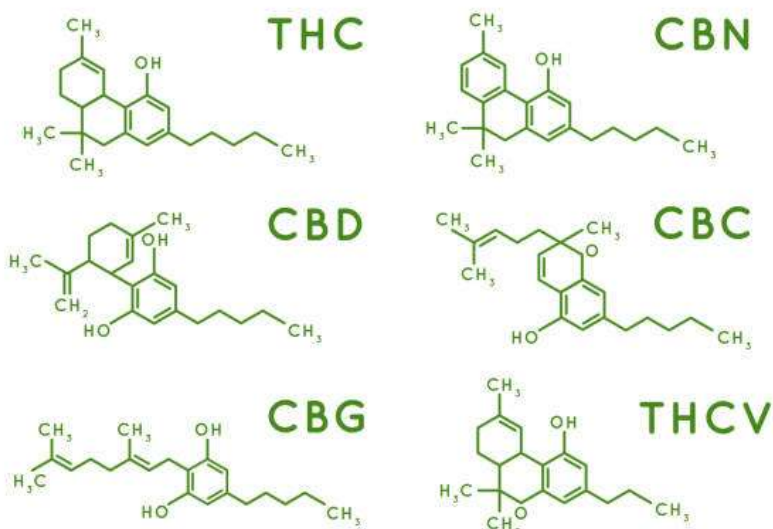


- Cannabinoid: “any of various naturally-occurring, biologically active, chemical constituents of cannabis”
- There are many cannabinoids found within the cannabis plant (at least 113)
 - Delta 9 THC (THC) is the most well-known of these cannabinoids as it is the principal psychoactive contributor
 - Cannabidiol (CBD) is another commonly known cannabinoid
- Cannabinoids are lipophilic, accumulating within fatty tissues.
 - Can persist in the body for weeks to months.

[Alizpurua-Olaizola 2016]

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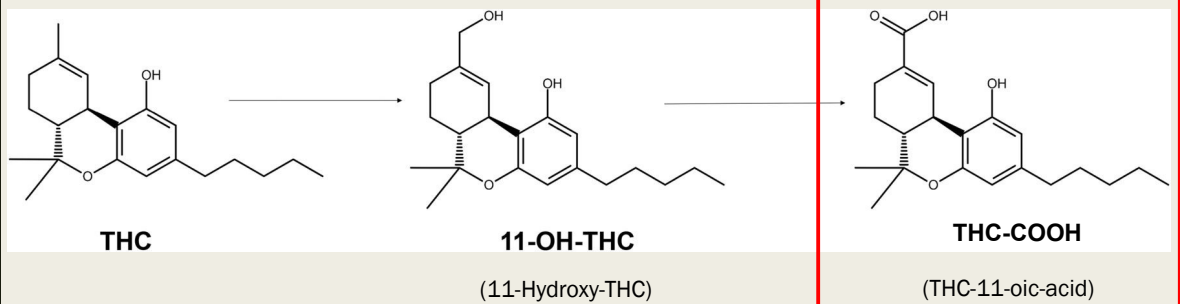
TABLE OF CANNABINOIDS



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THC Metabolites

- 11-OH-THC (11-Hydroxy-THC) is the initial main active metabolite of THC
- THC-COOH (THC-11-oic-acid), an inactive metabolite of delta-9-THC, has a much longer half life



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Consumption of Cannabis

- Recreational cannabis most commonly consumed by smoking, ingestion, and vaporization
- Medical cannabis administered via pill, cream, oil, nebulizer forms as well

Cannabis pills



Smokable cannabis



Baked goods

Skin cream

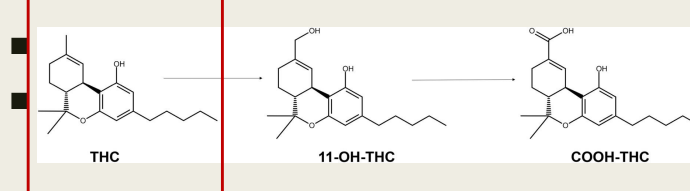


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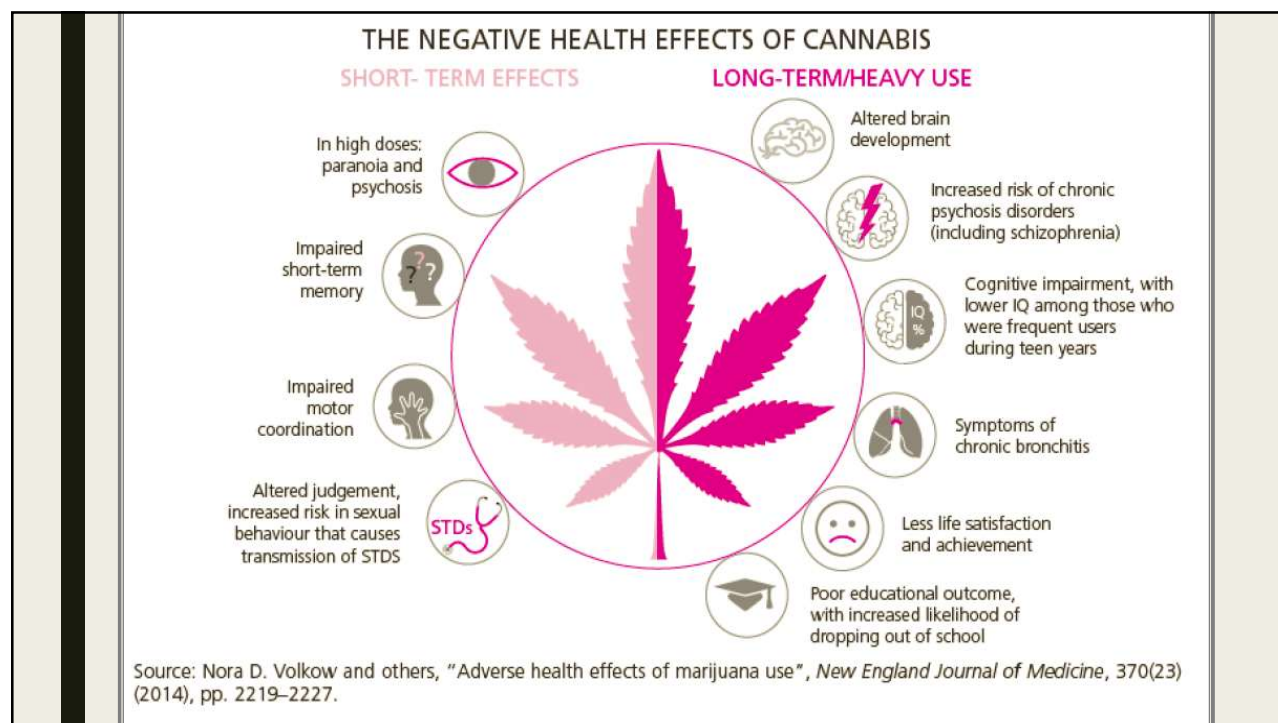


Desired Effects of Cannabis

- Euphoria
- Sense of relaxation



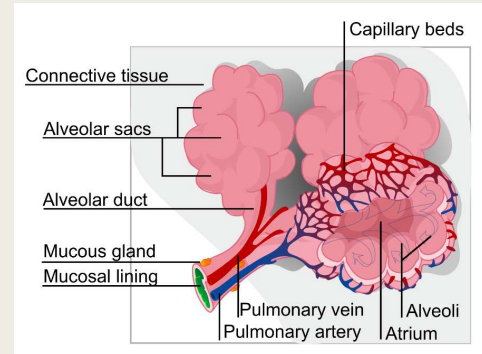
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Lung Absorption of THC

- Efficient pulmonary absorption
 - THC blood levels rise immediately
 - Peak blood concentration within 3-10 minutes
- Subjective high occurs within minutes

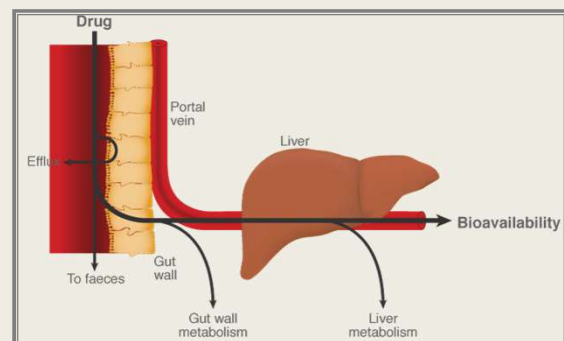


[Verstraete 2004]

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Oral Absorption of THC

- First pass liver metabolism impacts bioavailability of THC
 - Reduces by 4-12%
- Maximum THC blood concentration within 1-2 hours
- THC reaches the brain more slowly
 - High occurs ~ 30 minutes
- Lower peak concentrations, longer duration of effects



[Sharma 2012]

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DRUG TESTING FOR CANNABIS

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When Can Drug Testing Occur?

- Pre-employment
- Reasonable Suspicion
- Random
- Return-to-duty
- Follow-up
- Post-Accident



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Forms of Drug Testing to Consider

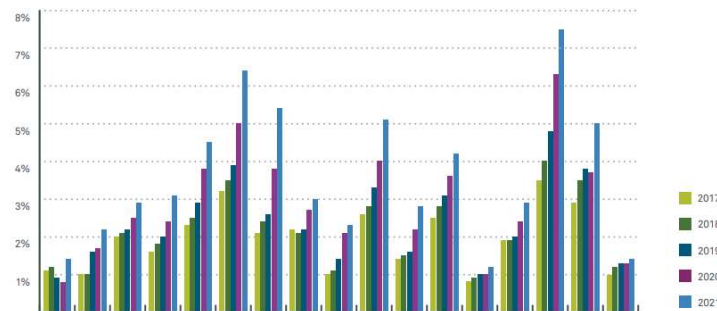
- Urine
- Blood
- Saliva
- Hair



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Positivity Rates by Drug: Marijuana | Industry Insights

Urine Drug Tests - General US Workforce



Industry	2017	2018	2019	2020	2021
Accommodation and Food Services ⁷²	3.5%	4.0%	4.8%	6.3%	7.5%
Administrative Support, Waste Management and Remediation Services ⁵⁶	2.5%	2.8%	3.1%	3.6%	4.2%
Construction ²³	2.0%	2.1%	2.2%	2.5%	2.9%
Educational Services ⁶¹	0.81%	0.92%	1.0%	1.0%	1.2%
Finance and Insurance ⁵²	1.0%	1.1%	1.4%	2.1%	2.3%
Health Care and Social Assistance ⁶²	1.9%	1.9%	2.0%	2.4%	2.9%
Information ⁵¹	2.2%	2.1%	2.2%	2.7%	3.0%
Manufacturing ³¹⁻³³	1.6%	1.8%	2.0%	2.4%	3.1%
Mining ²¹	1.1%	1.2%	0.91%	0.79%	1.4%
Other Services (except Public Administration) ⁸¹	2.9%	3.5%	3.8%	3.7%	5.0%
Professional, Scientific and Technical ⁵⁴	1.4%	1.5%	1.6%	2.2%	2.8%
Public Administration ⁹²	0.98%	1.2%	1.3%	1.3%	1.4%
Real Estate, Rental and Leasing ⁵⁹	2.6%	2.8%	3.3%	4.0%	5.1%
Retail Trade ⁴⁴⁻⁴⁵	3.2%	3.5%	3.9%	5.0%	6.4%
Transportation and Warehousing ⁴⁸⁻⁴⁹	2.1%	2.4%	2.6%	3.8%	5.4%
Utilities ²²	1.0%	1.0%	1.6%	1.7%	2.2%
Wholesale Trade ⁶⁴	2.3%	2.5%	2.9%	3.8%	4.5%

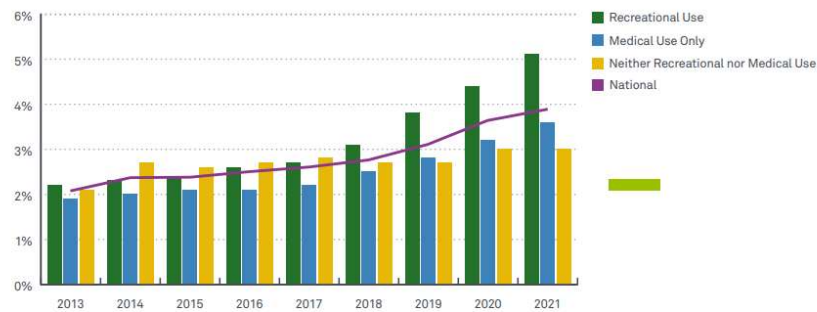
(More than 16 million tests from 2017 - 2021)

2022 | Industry Insights: Quest Diagnostics Drug Testing Index | 43

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Marijuana Positivity by 2021 State Legalized Use Status – Urine Drug Tests | Annual Report

For General US Workforce, as a Percentage of All Tests for Marijuana Metabolite



More than 6 million tests from January to December 2021

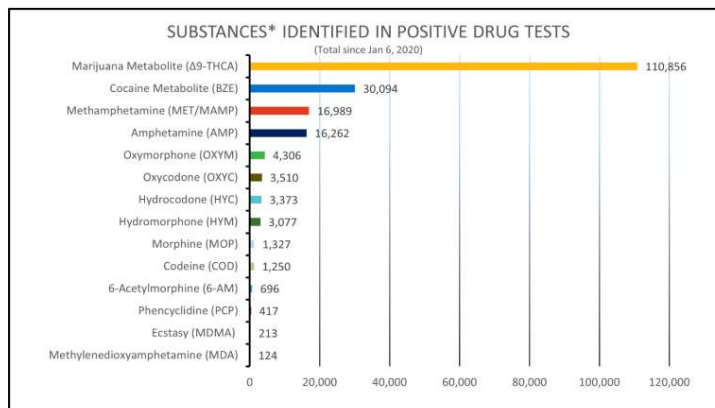
Drug Category	2013	2014	2015	2016	2017	2018	2019	2020	2021
Recreational Use	2.2%	2.3%	2.4%	2.6%	2.7%	3.1%	3.8%	4.4%	5.1%
Medical Use Only	1.9%	2.0%	2.1%	2.1%	2.2%	2.5%	2.8%	3.2%	3.6%
Neither Recreational nor Medical Use	2.1%	2.7%	2.6%	2.7%	2.8%	2.7%	2.7%	3.0%	3.0%
National	2.1%	2.4%	2.4%	2.5%	2.6%	2.8%	3.1%	3.6%	3.9%

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DRUG & ALCOHOL CLEARINGHOUSE

U.S. Department of Transportation
Federal Motor Carrier Safety Administration

VIOLATIONS REPORTED TO CLEARINGHOUSE CONTINUED



*Positive drug tests reported through March 2023, as of April 1, 2023.

The graph above shows total results reported to the Clearinghouse since January 6, 2020 of the number of times a driver tested positive for each substance.

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SUBSTANCES IDENTIFIED IN POSITIVE DRUG TESTS

Substance	2020	2021	2022	2023	# Tests Identified*
Marijuana Metabolite (Δ^9 -THCA)	29,511	31,085	40,916	9,344	110,856
Cocaine Metabolite (BZE)	7,940	8,765	10,953	2,436	30,094
Methamphetamine (MET/MAMP)	5,187	5,082	5,569	1,151	16,989
Amphetamine (AMP)	4,953	4,904	5,349	1,056	16,262
Oxymorphone (OXYM)	1,372	1,276	1,398	260	4,306
Oxycodone (OXYC)	1,106	1,049	1,130	225	3,510
Hydrocodone (HYC)	1,082	1,048	1,042	201	3,373
Hydromorphone (HYM)	1,000	930	965	182	3,077
Morphine (MOP)	443	353	445	86	1,327
Codeine (COD)	386	329	444	91	1,250
6-Acetylmorphine (6-AM)	302	191	177	26	696
Phencyclidine (PCP)	137	118	138	24	417
Ecstasy (MDMA)	65	60	68	20	213
Methylenedioxymphetamine (MDA)	30	33	45	16	124
All substances	53,514	55,223	68,639	15,118	192,494

(Reported through March 2023, as of April 1, 2023)

*Total since January 6, 2020

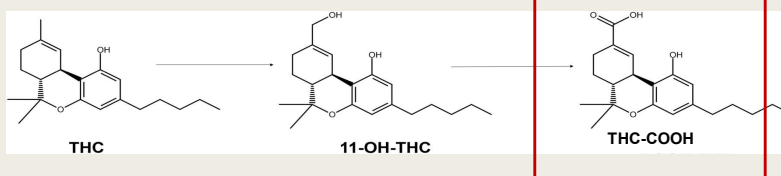
Note: More than one substance can appear in a positive drug test

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Urine Drug Testing for Cannabis



- Most commonly detects THC-COOH
- Typical screening cutoff: 50ng/ml
- Gas Chromatography/Mass Spectrometry (confirmatory test) cutoff: 15ng/ml



[Verstraete 2004]

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Urine Cannabis Metabolite Timeline

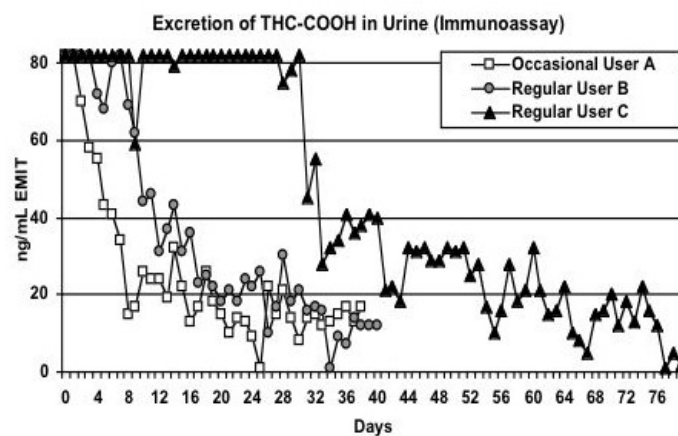
- The ability to detect the inactive THC metabolite (THC-COOH) in urine is unpredictable.
 - Infrequent users: 1-5 day detection period
 - Heavy users: Up to 15 days
 - Chronic users: Up to 30 days
 - Oral ingestion has slightly longer detection times of THC-COOH



[Verstraete 2004]

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Urine Testing - Regular Use



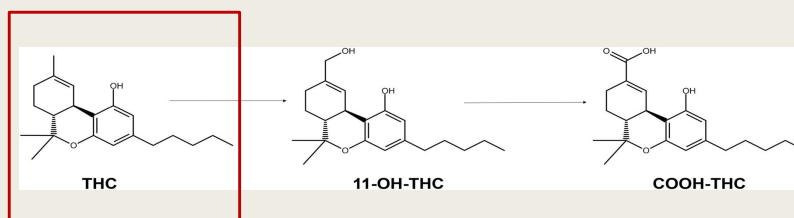
(F. Grotenhemer, Cannabiskonsum, Straßenverkehr und Arbeitswelt; from GM Ellis et al., Excretion patterns of cannabinoid metabolites after last use in a group of chronic users. *Clin Pharmacol Ther* 1985;38(5):572-578.)

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Blood Drug Testing for Cannabis



- THC detectable for ~ 5-8 hours
 - Rises quickly in the minutes following inhalation (often above 100 ng/ml), quickly declines to single digit levels within a couple of hours
- Indicator as to whether one is under the influence of cannabis?



[Verstraete 2004]

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Metabolite Persistence in Blood

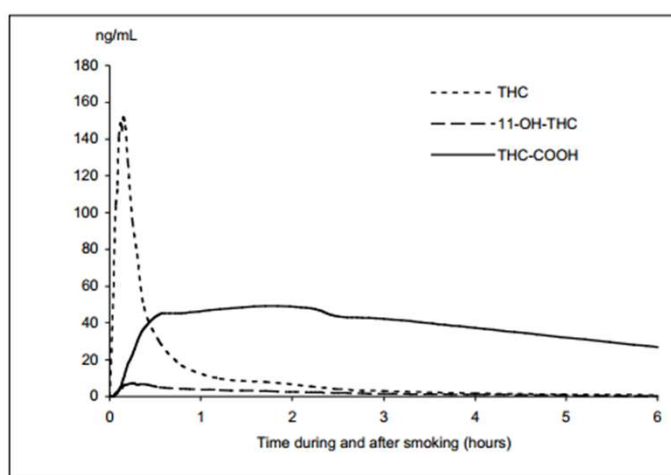
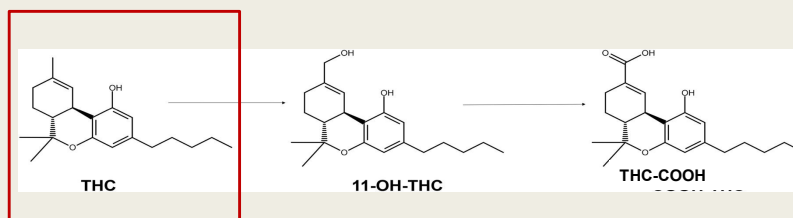


Figure 1 Mean plasma concentrations of THC and its metabolites 11-OH-THC and THC-COOH for six subjects smoking a cannabis cigarette containing 34 mg THC (drawn from data in Huestis et al. 1992).

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Saliva Drug Testing for Cannabis

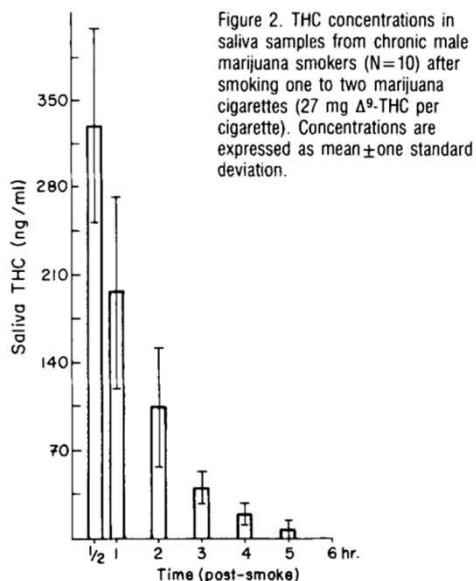
- Shorter window of detection – parent compounds, not inactive metabolites
- Parent compound – Delta 9 THC
- Detection time 6-12 hours



[Verstraete 2004]

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Metabolite Persistence in Saliva



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Airline and Railway, Drug Testing, Trucking & Logistics

U.S. Department of Transportation Approves Oral Fluid Testing for Drug Testing

May 8, 2023

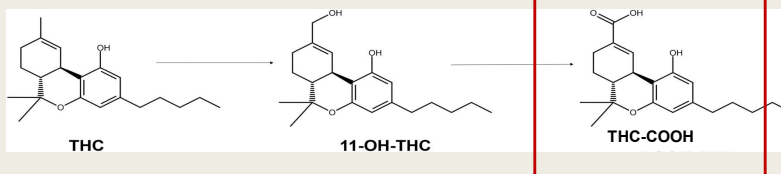
- Effective June 1, 2023
- Does NOT replace urine testing
 - The choice of whether to conduct an oral fluid or a urine test is up to the employer

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Hair Drug Testing for Cannabis



- Longest detection period
 - ~ 90 days with 1.5 inches of growth
- Measure of THC-COOH – inactive metabolite



[Uhl 1997]

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IMPAIRMENT

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Why isn't this as easy as alcohol?

- Pharmacokinetics are more complex
 - *Vape/Smoke*
 - Rapid peak in blood concentrations
 - Transient peak in blood concentrations
 - *Ingest*
 - Slow peak in blood concentrations
- No clear relationship between THC blood concentrations and impairment
 - *Ginsburg (2019)*

Approximate Blood Alcohol Content (BAC) In One Hour
Source: National Highway Traffic Safety Administration

Drinks	Body Weight In Pounds								Influenced
	100	120	140	160	180	200	220	240	
1	.05	.04	.03	.03	.03	.02	.02	.02	Possibly
2	.09	.08	.07	.06	.05	.05	.04	.04	
3	.14	.11	.11	.09	.08	.07	.06	.06	Impaired
4	.18	.15	.13	.11	.10	.09	.08	.08	
5	.23	.19	.16	.14	.13	.11	.10	.09	Legally Intoxicated
6	.27	.23	.19	.17	.15	.14	.12	.11	
7	.32	.27	.23	.20	.18	.16	.14	.13	
8	.36	.30	.26	.23	.20	.18	.17	.15	
9	.41	.34	.29	.26	.23	.20	.19	.17	
10	.45	.38	.32	.28	.25	.23	.21	.19	

Subtract .015 for each hour after drinking.

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Impairment up to 24 hours?

Carry-Over Effects of Marijuana Intoxication
on Aircraft Pilot Performance: A Preliminary Report

Jerome A. Yesavage, M.D., Von Otto Leirer, Ph.D.,
Lt. Cdr. Mark Denari, and Leo E. Hollister, M.D.

Ten experienced licensed private pilots were trained for 8 hours on a flight simulator landing task. They each smoked a cigarette containing 19 mg of Δ^9 -tetrahydrocannabinol (THC), and 24 hours later their mean performance on the flight task showed trends toward impairment on all variables, with significant impairment in number and size of aileron changes, size of elevator changes, distance off center on landing, and vertical and lateral deviation on approach to landing. Despite these deficits, the pilots reported no awareness of impaired performance. These results may have implications for performance of complex tasks the day after smoking marijuana.

(Am J Psychiatry 142:1325–1329, 1985)

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Delta 9 THC leading to acute impairment

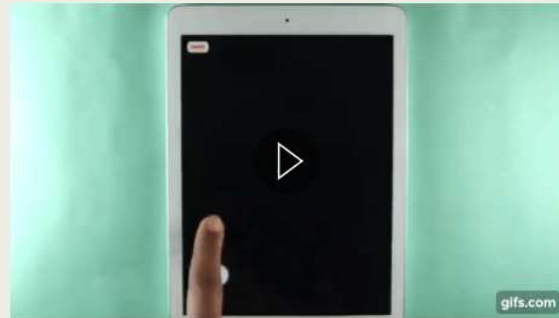
- Cognitive Function (Spindle et al, 2021)
 - Paced Serial Addition Task (**PASAT**)
 - *DRiving Under the Influence of Drugs* (**DRUID**)
- On-Road, Simulated Driving Performance (Arkell et al, 2019)
 - “Moderately increased risk” of being involved in / responsible for motor vehicle collision
 - Standard Deviation of Lane Positioning (SDLP) increased
 - Average driving speed typically not affected



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DRUID

- Two minutes
- Four tasks
 - Circle vs. Square (Decision Making)
 - 60 seconds (Time Estimation)
 - Trace the circle (Object Tracking)
 - Stand on one leg (Balance)
- Issues?
 - Obtaining a baseline
 - What is causing the impairment (alcohol vs. cannabis vs. other)?
 - Could cannabis actually improve scoring in certain conditions?



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An attempt to assess impairment... (Spindle et al. 2021)

- Infrequent cannabis users (no use for 30 days prior to study onset)
- Acute administration of cannabis
 - Oral
 - 0, 10, 25mg THC (brownies)
 - Vaporized
 - 0, 5, 20mg THC
- Impairment
 - Self-report
 - Cognitive testing
 - Field sobriety testing

Journal of Psychopharmacology
Volume 35, Issue 7, July 2021, Pages 786-803
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<https://doi.org/10.1177/02698111211021583>



Original Papers

Assessment of cognitive and psychomotor impairment, subjective effects, and blood THC concentrations following acute administration of oral and vaporized cannabis

Tory R Spindle¹, Erin L Martin², Megan Grabenauer³, Thomas Woodward⁴, Michael A Milburn⁵, and Ryan Vandrey¹

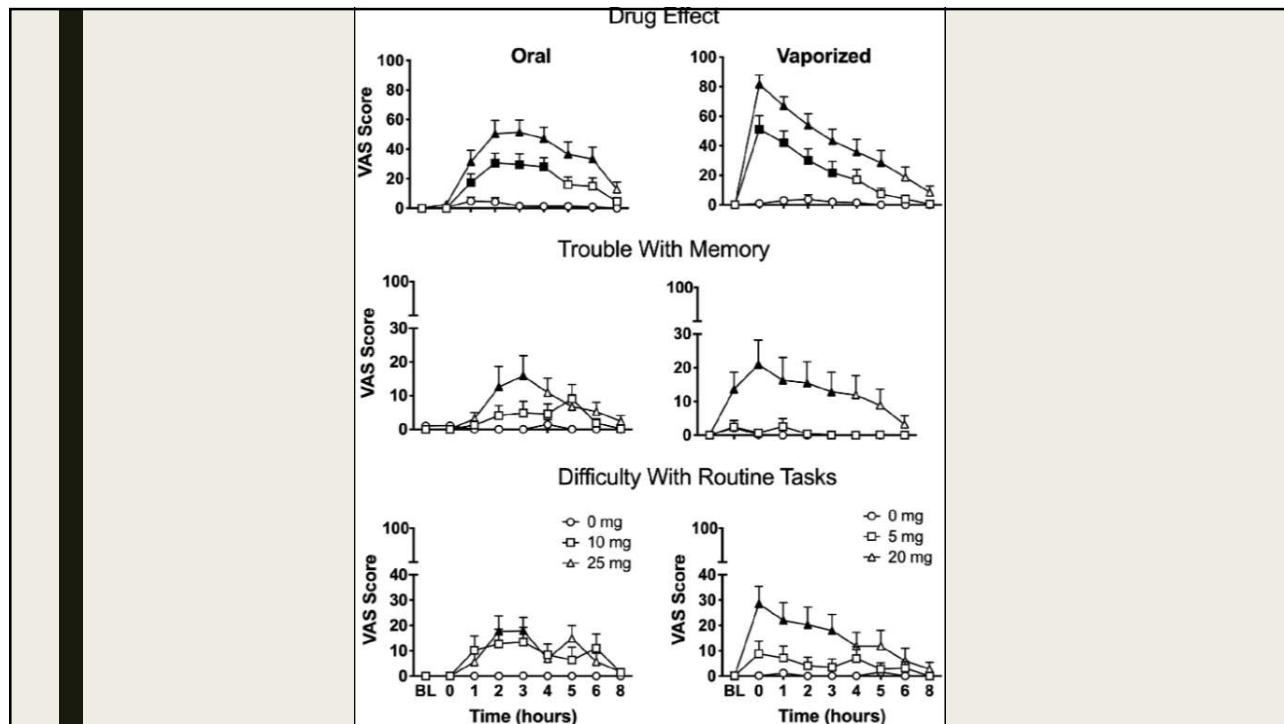
Background: Cannabis legalization is expanding, but there are no established methods for detecting cannabis impairment.

Aim: Characterize the acute impairing effects of oral and vaporized cannabis using various performance tests.

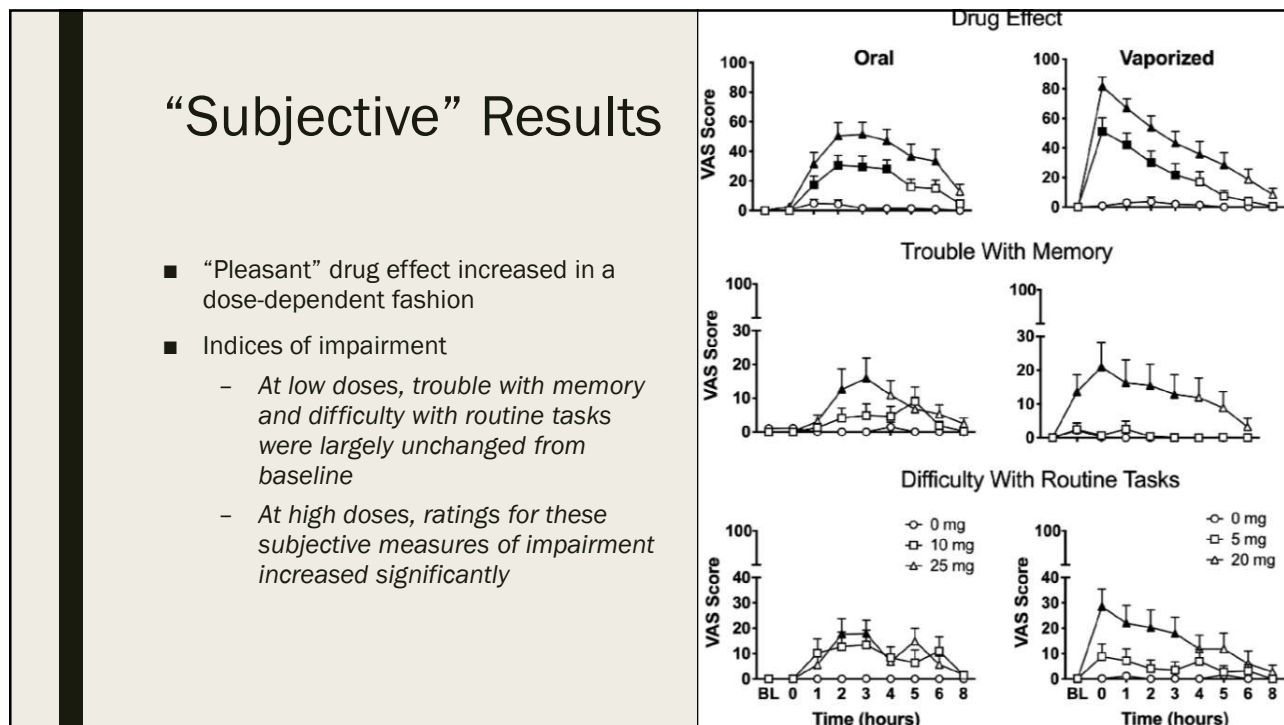
Methods: Participants ($N = 20$, 10 men/10 women) who were infrequent cannabis users ingested cannabis brownies (0, 10, and 25 mg Δ -9-tetrahydrocannabinol, THC) and inhaled vaporized cannabis (0, 5, and 20 mg THC) in six double-blind outpatient sessions. Cognitive/psychomotor impairment was assessed with a battery of computerized tasks sensitive to cannabis effects, a novel test (the DRIVING Under the Influence of Drugs, DRUID[®]), and field sobriety tests. Blood THC concentrations and subjective drug effects were evaluated.

Results: Low oral/vaporized doses did not impair cognitive/psychomotor performance relative to placebo but produced positive subjective effects. High oral/vaporized doses impaired cognitive/psychomotor performance and increased positive and negative subjective effects. The DRUID[®] was the most sensitive test to cannabis impairment, as it detected significant differences between placebo and active doses within both routes of administration. Women displayed more impairment on the DRUID[®] than men at the high vaporized dose only. Field sobriety tests showed little sensitivity to cannabis-induced impairment. Blood THC concentrations were far lower after cannabis ingestion versus inhalation. After inhalation, blood THC concentrations typically returned to baseline well before pharmacodynamic effects subsided.

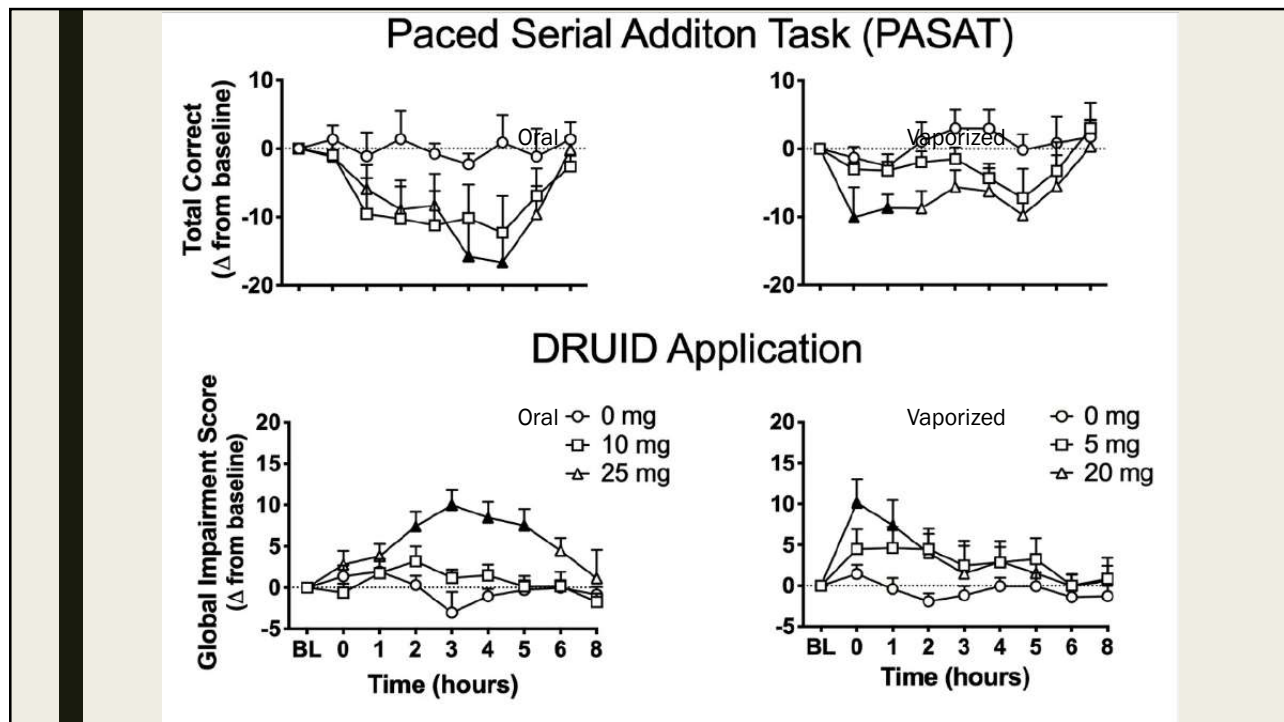
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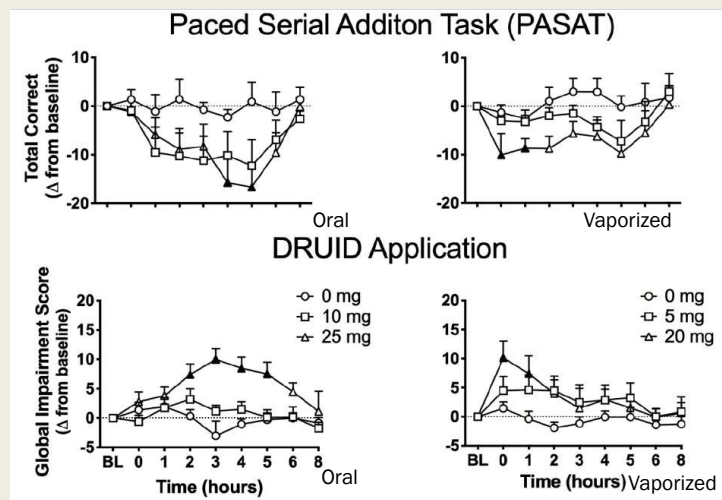
Cognitive Results

■ PASAT

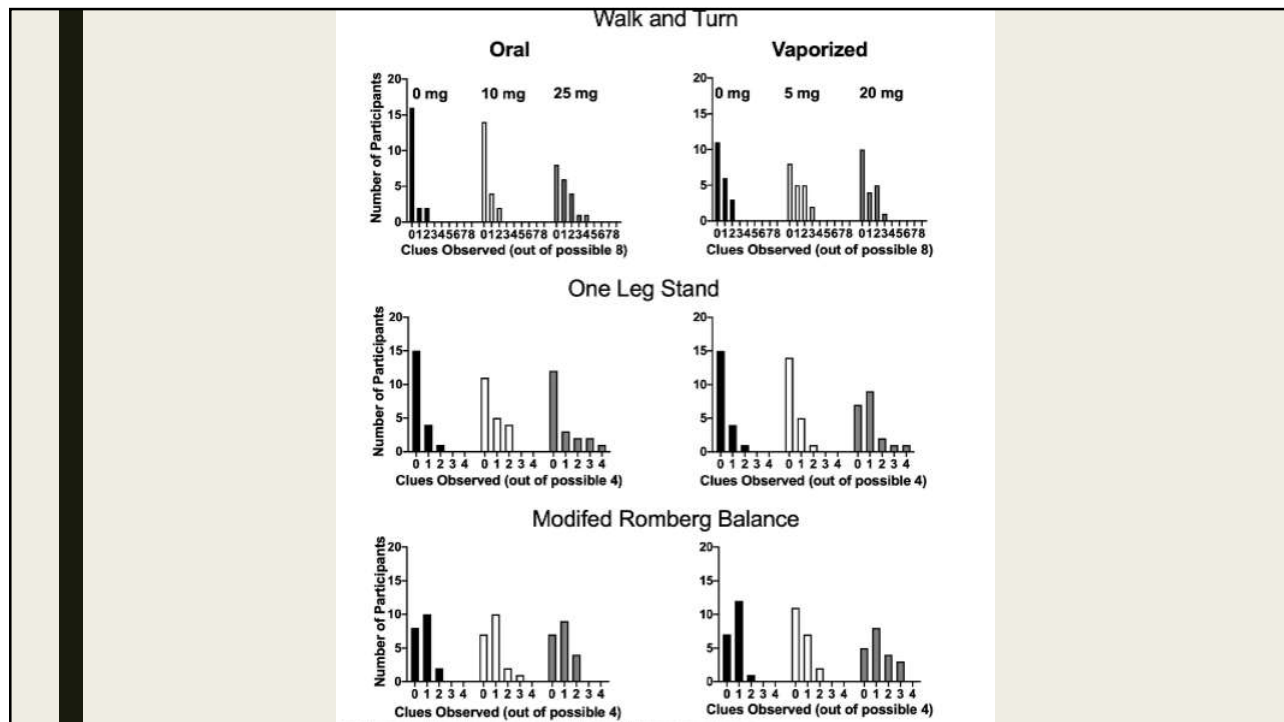
- Negative impact
- Mirror subjective drug effect rating

■ DRUID

- Negative impact
- Multiple performance domains



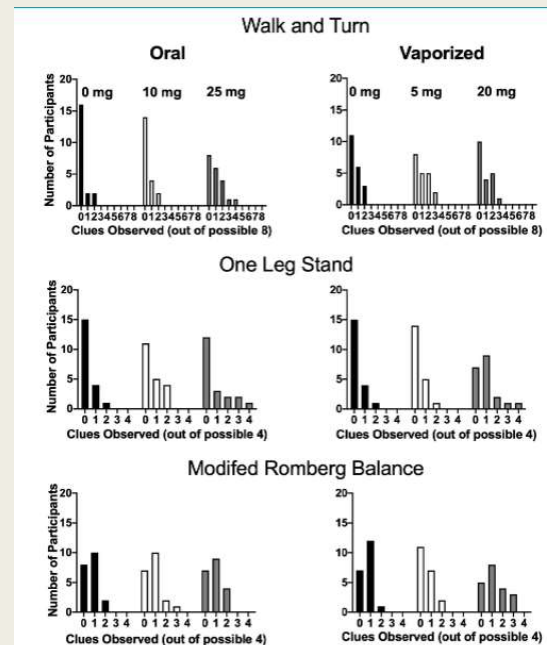
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Field Sobriety Testing

- “Impaired” = 2 or greater clues
- Individual “clues” detected at comparable rate
 - Placebo, low dose, high dose THC
- Does field sobriety testing lack sensitivity for cannabis impairment?
 - vs. alcohol
- Not a “real world” scenario
 - Multiple “practice” attempts
 - Low stress



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Summary

- Landscape surrounding cannabis has changed (and will continue to change)
- Mode of consumption matters
- Method of testing, metabolite of testing – it makes a difference!
- Impairment remains difficult to assess



SUMMARY

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