CRIME LAB

ORANGE COUNTY, CALIFORNIA

Learning Objectives

- Learn the history of OCCL's DUID/cannabinoid program

- Become familiar with the testing workflow for cannabinoids

- Become familiar with trends and prevalence of cannabinoids in DUI cases

- Become familiar with the depth of training and testimony provided

OCCL DUID Program History

- In 2010, Orange County agencies (OCDA and OC Crime Lab) determined there was a rise in DUI- Drug cases.

- In 2011 OCDA applied for a grant from the California Office of Traffic Safety (OTS) for DUID collaboration.

- Program involved 3-part collaboration and presented a unique model for testing, investigation and prosecution.

Goals of the OCCL DUID program

▶ Train and dedicate misdemeanor vertical prosecutors to handle DUID cases.

▶ Train officers to become certified DREs (Drug Recognition Experts).

▶ Provide latest testing equipment and staffing for the OC Crime Lab.

OC – DUID program- accomplishments to Date

Prosecution:

- Trained dozens of Deputy District Attorneys to become DUID experts; We currently have 8 DUID attorneys (2 in each branch court);

- OCDA team received a NHTSA Public Safety Award in 2016;

Law Enforcement:

- Received 100% participation from Orange County police agencies in the law enforcement training component; To date, hundreds of officers have been trained as Drug Recognition Experts (DRE)

OC Crime Lab:

- The only antemortem & postmortem Toxicology Section in So Cal at the OC Crime Lab.

- In 2014, OCCL received an Achievement Award from the National Association of Counties

- Expanded Toxicological services
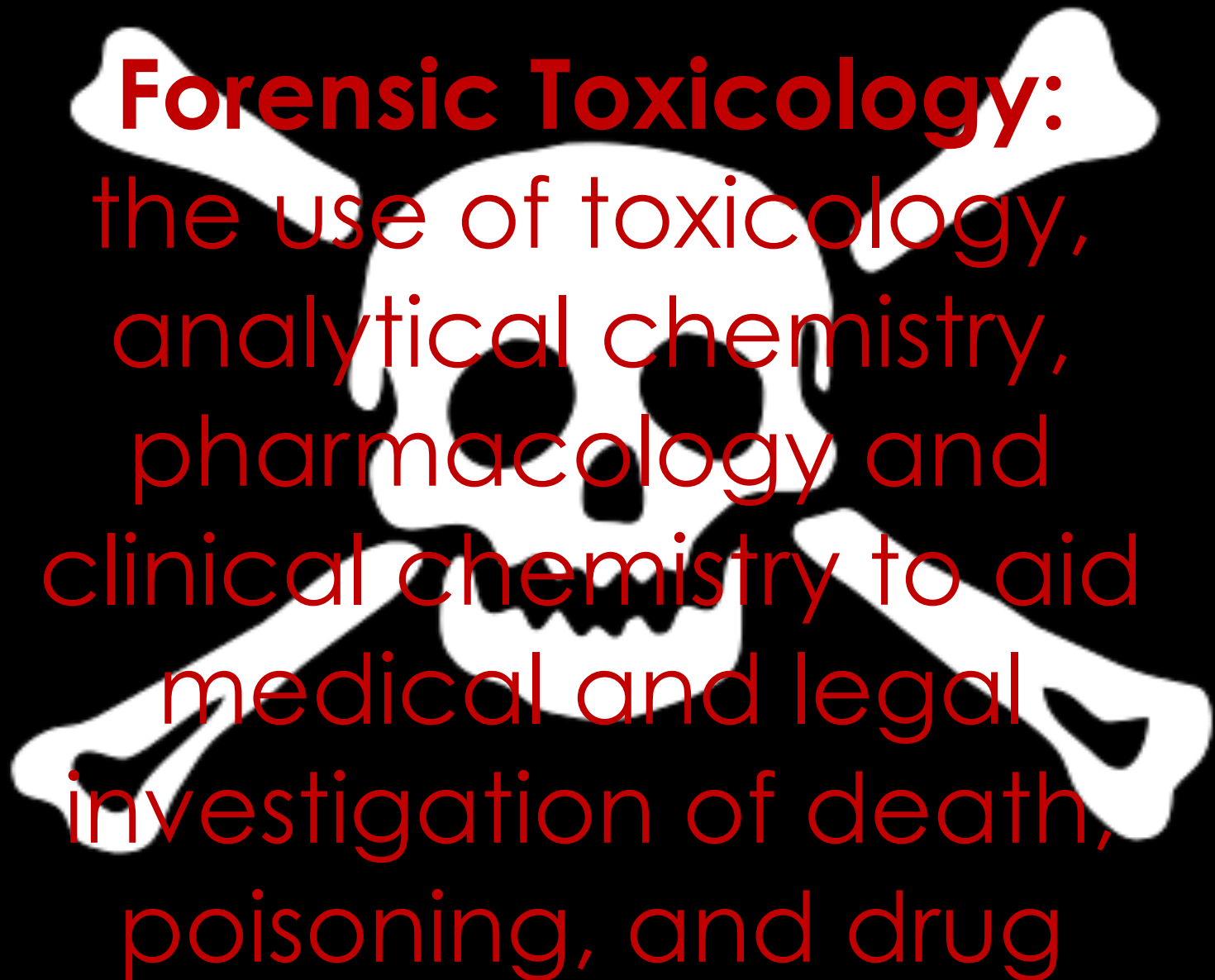
- Currently 5 DUID interpretation analysts

Lab Funding for DUID

- **OTS Funding to Date: $1,800,000**

- **Other Grants: $195,000 (NIJ & JAG)**

- **County Funding for Equipment: $800,000**

- **OCSD Funding for Equipment: $1,600,000**

- **CHP funding for Equipment: $467, 700**

Forensic Toxicology: the use of toxicology, analytical chemistry, pharmacology and clinical chemistry to aid medical and legal investigation of death, poisoning, and drug

How does the OCCL process a DUID case?

- Orange County utilizes contracted on-call phlebotomists with mandated 1 hr response time

- All blood cases with driving violations are tested for ethanol and other volatiles.

- All DUI cases since August 1st, 2017 are screened for drugs.

- All positive screens are confirmed.

- All drug requests are conducted if reasonable and sufficient sample volume is provided.

- All **DRE** samples are comprehensively tested including all requests regardless of charge.

LCMS – Time of Flight

Testing

1-(4-chlorobenzhydryl)-piperazine, 2-Hydroxyethylflurazepam, 2-Oxo-3-hydroxy-LSD, 4-ANPP, 6-Acetylcodeine, **6-Monoacetylmorphine**, 7-Aminoclonazepam, 7-Aminoflunitrazepam, 7-Hydroxymitragynine, 9-Hydroxyrisperidone, Acepromazine, Acetaminophen, Acetylfentanyl, alpha-Hydroxyalprazolam, alpha-Hydroxytriazolam, Albuterol, **Alprazolam**, Amantadine, Amitriptyline, Amoxapine, Anhydroecgonine methyl ester, Antipyrine, Aripiprazole, Asenapine, Atomoxetine, Atropine, Baclofen, Benzoylecgonine, Benztropine, Benzylpiperazine, Bromazepam, Bromperidol, Brompheniramine, Bupivacaine, **Buprenorphi**ne, Buprenorphine-glucuronide, Bupropion, Buproprion-Hydroxy metabolite, Buspirone, Butorphanol, Caffeine, Carbamazepine, Carbinoxamine, **Carisoprodol**, Cathinone, Chlordiazepoxide, Chlorpheniramine, Chlorpromazine, Chloroquine, Citalopram, Clobazam, Clomipramine, Clonazepam, Clonazolam, Clopamide, Clozapine, Cocaethylene, **Cocaine**, Codeine, Codeine-glucuronide, Cyclobenzaprine, Dantrolene, Demoxepam, Desalkylflurazepam, Desipramine, Desmethylclobazam, Diazepam, Diclazepam, Diclofenac, Dicyclomine, Dihydrocodeine, Dihydrocodeine-glucuronide, Diltiazem, **Diphenhydramin**e, Diphenidine, Diphenoxylate, Donepezil, Doxepin, Doxylamine, Duloxetine, Ecgonine ethyl ester, Ecgonine methyl ester, EDDP, EMDP, Ephedrine/Pseudoephedrine, Ephenidine, Estazolam, **Ethylone**, **Etizolam**, Etodolac, Etomidate, Fenproporex, **Fentanyl,** Flecainide, Flubromazolam, Flumazenil, Flunitrazepam, Fluoxetine, Flurazepam, Fluvoxamine, Furanyl fentanyl, **Gabapentin**, Guaifenesin, Halazepam, **Haloperidol**, Harmine, Heroin, Homatropine, **Hydrocodone**, Hydromorphone, Hydromorphone-glucuronide, Hydroxychloroquine, Hydroxyzine, Imipramine, **Ketamine**, Lacosamide, Lamotrigine, Lefetamine, Levallorphan, Levamisole, Levetiracetam, Levomepromazine, Levorphanol, Lidocaine, Loperamide, Loratadine, Lorazepam, Lorazepam-glucuronide, Lormetazepam, Loxapine, Lurasidone, **Lysergic Acid Diethyl Amide**, Meclizine, Medazepam, Memantine, Meperidine, Mepivacaine, Meprobamate, Mescaline, **Metaxalone**, Metformin, **Methadone**, Methaqualone, Methcathinone, Methiopropamine, Methocarbamol, Methorphan, Methoxetamine, Methoxyacetyl fentanyl, Methylenedioxyamphetamine, **Methylenedioxymethamphetamine**, Methylone, Methylphenidate, Metoclopramide, Metoprolol, Midazolam, Mirtazapine, **Mitragynine**, Morphine, Morphine-glucuronide, Nabumetone, Naloxone, Naltrexone, Naphyrone, Naproxen, N-desmethylclozapine, N-desmethylcyclobenzaprine, N-desmethylmirtazapine, N-desmethyltramadol, N-ethylpentylone, Nefazodone, Nicotine, Nitrazepam, Norbuprenorphine, Norbuprenorphine-glucuronide, Norchlordiazepoxide, Norcitalopram, Norclomipramine, Norcodeine, Nordiazepam, Nordoxepin, Norfentanyl, Norflunitrazepam, Norfluoxetine, Norhydrocodone, Norketamine, Normeperidine, Noroxycodone, Norpropoxyphene, Norquetiapine, Norsertraline, Nortriptyline, Norverapamil, Noscapine, o-Desmethyltramadol, o-Desmethylvenlafaxine, **Olanzapine**, Ondansetron, Orphenadrine, Oxazepam, Oxazepam-glucuronide, Oxcarbazepine, **Oxycodone**, Oxymorphone, Papaverine, Paroxetine, Pentazocine, Pentoxifylline, Pentylone, Phenazepam, **Phencyclidine**, Phendimetrazine, Pheniramine, Phenmetrazine, Phentermine, Phenylbutazone, Phenylephrine, Phenylpropanolamine, **Phenytoin,** Pramoxine, Prazepam, Pregabalin, Procaine, Prochlorperazine, Promethazine, Propoxyphene, Propranolol, Propylhexadrine, Protriptyline, Pyribenzamine, Pyrilamine, Quetiapine, Quinapril, Quinidine/Quinine, Ramelteon, Reboxetine, Reserpine, Retigabine, Risperidone, Rizatriptan, Ropinirole, Ropivacaine, Rosiglitazone, Rufinamide, Salvinorin B, Sertraline, Sildenafil, Sotalol, Spirapril, Strychnine, Sufentanil, Sulindac, Sulpiride, Sumatriptan, Suvorexant, Suxibuzone, Tadalafil, Tapentadol, Tapentadol-glucuronide, Telmisartan, Temazepam, Temazepam-glucuronide, Tenocyclidine, Terazosin, Terbutryn, Terconazole, TFMPP, Thebaine, Thiamazole, Thioridazine, Tiagabine, Tiletamine, Tilidine, Tizanidine, Tolmetin, **Tramadol, Trazodone,** Triamterene, Triazolam, Trifluoperazine, Trifluperidol, Trihexyphenidyl, Trimethoprim, Triprolidine, **U-47700, U-49900,** Venlafaxine, Verapamil, Vilazodone, Warfarin, Xylazine, Yohimbine, Zaleplon, Ziprasidone, Z**olpidem**, Zonisamide, Zopiclone, Zotepine

Also Test for…

- Amphetamine
- Barbiturates
- Cannabinoids
- Methamphetamine and Related*

We confirm all positives and determine blood concentrations on more than 70 different compounds.

MORPHINE

METHADONE CODEINE

COCAINE

HYDROCODONE OXYCODONE DIPHENHYDRAMINE

ZOLPIDEM CITALOPRAM FENTANYL CLOBAZEPAM DIAZEPAM LORAZEPAM OXAZEPAM

ALPRAZOLAM

THC

METHAMPHETAMINE

Cannabinoids

▶ Delta-9-Tetrahydrocannabinol (THC)

▶ 11-nor-9-carboxy- Delta-9-Tetrahydrocannabinol (THCA)

▶ 11-hydroxy- Delta-9-Tetrahydrocannabinol (OH-THC)

▶ Cannabinol (CBN)

▶ Cannabidiol (CBD)

Cannabis Related Initiatives - Research

Drug Prevalence

- *THC concentrations in DUI populations (per se)*
- *THC in alcohol positive DUI samples*

Drug Stability

- *THC and metabolites in antemortem and postmortem samples*

Effectiveness of DRE, SFST

- A 2-year Study of THC Concentrations in Drivers: Examining Driving and FST Performance
- *A 2-year Study of THC Concentrations in Drivers: Physiological Signs on DRE & non-DRE*
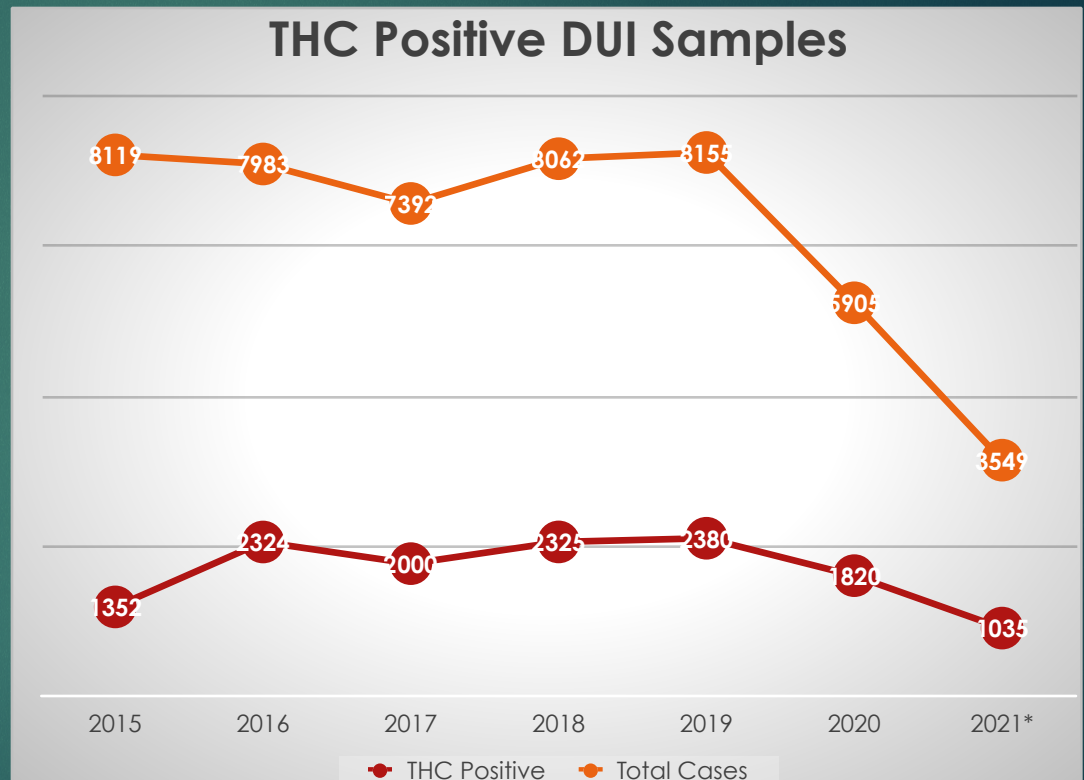
DUI cases with THC

2015. - 17%

2016. - 29%

2017. - 27%

2018. - 29%

2019. - 29%

2020. - 30%

2021. - 29%

THC Positive DUI Samples

	2015	2016	2017	2018	2019	2020	2021*
Total Cases	8119	7983	7392	8062	8155	5905	3549
THC Positive	1352	2324	2000	2325	2380	1820	1035

THC Positive   Total Cases

2018-2019 OC DUI Cannabis Demographics

Male

- 82%
- Average Age: 29
- <21 years old: 14%
- <25 years old: 42%
- Age Range: 15-77

Female

- 18%
- Average Age: 30
- <21 years old: 10%
- <25 years old: 38%
- Age Range: 17-95

5 ng/mL per se or rebuttalable inference?!

Where did 5 ng/mL come from?

"The highest level of a nearly 3-fold culpable accident involvement (OR:2.84,CI 1.44-5.60) was found with a THC value between **3-5 ng/mL** of whole blood. Impairment produced by **2 ng/mL** of THC in whole blood was equated to a **0.05%** ethanol level."

Knoche, A. (2013). Proceedings from International Council on Alcohol, Drugs and Traffic Safety 2013: *Per se limits – recommendations for defining cut-off values for psychoactive substance use in traffic.* Brisbane, Australia.

Pre-Legalization

▶ What was the distribution of THC concentrations in current apprehended drivers?

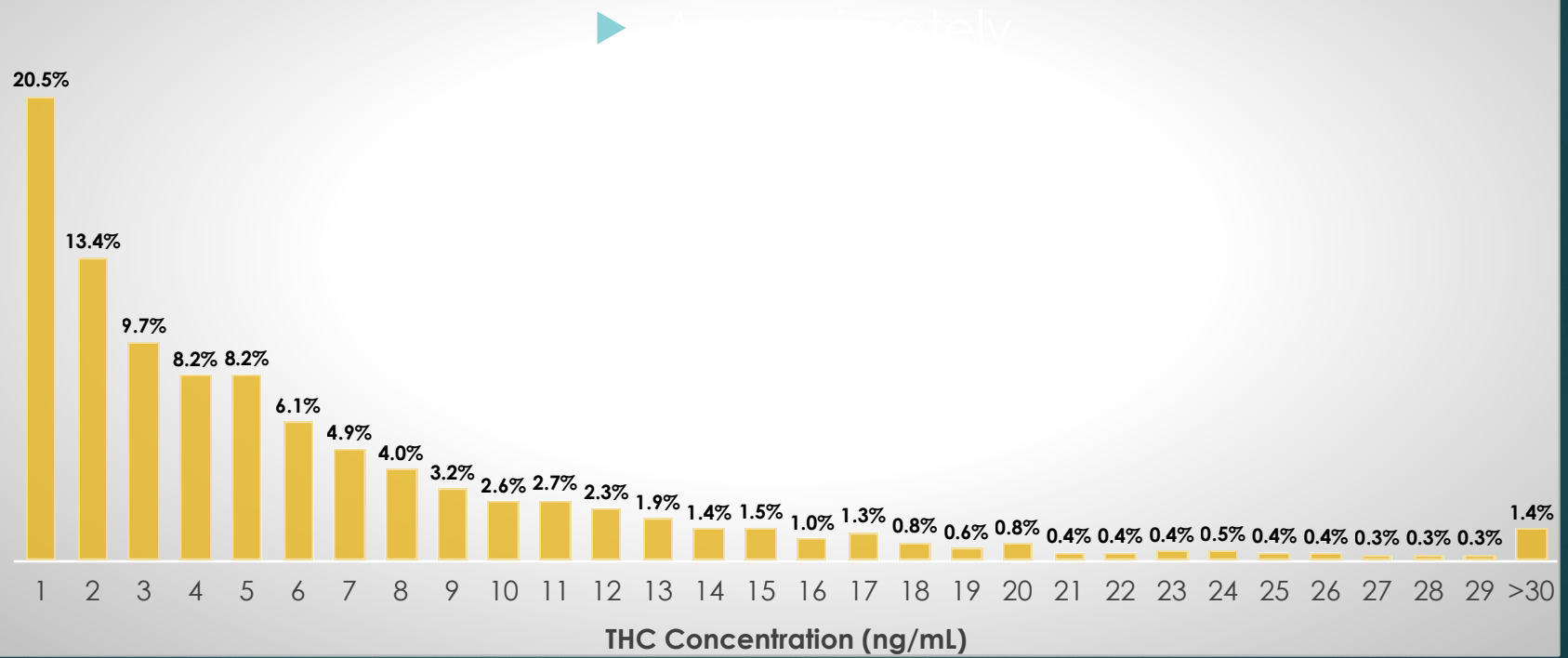▶ Survey of labs (Labs covering 51 of 58 counties responded)

Statewide THC Concentration Survey

Statewide Representation THC Concentration Distribution

Years	Number of THC Exams	Number >5.0 ng/mL	% Not Eligible for 5 ng/mL Per Se
2009-2016	13335	5312	**60.2**

2019 Orange County THC Concentrations

AAA per se evaluation

- DRE data from drivers arrested for DUI where only THC present
  - Drug free control population used as comparison
  - Data collected from AZ, CA, CO, MT, TX, WI

- 50% of subjects arrested for DUI had THC less than 4 ng/mL

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What does this mean???

There is no scientific threshold

for impairment from THC!

Conclusion

- There are many factors that can affect the tested levels of THC in the blood

- Driving impairment can occur at varying levels of THC

- Depending on the per se chosen, a large portion of impaired individuals could be missed!
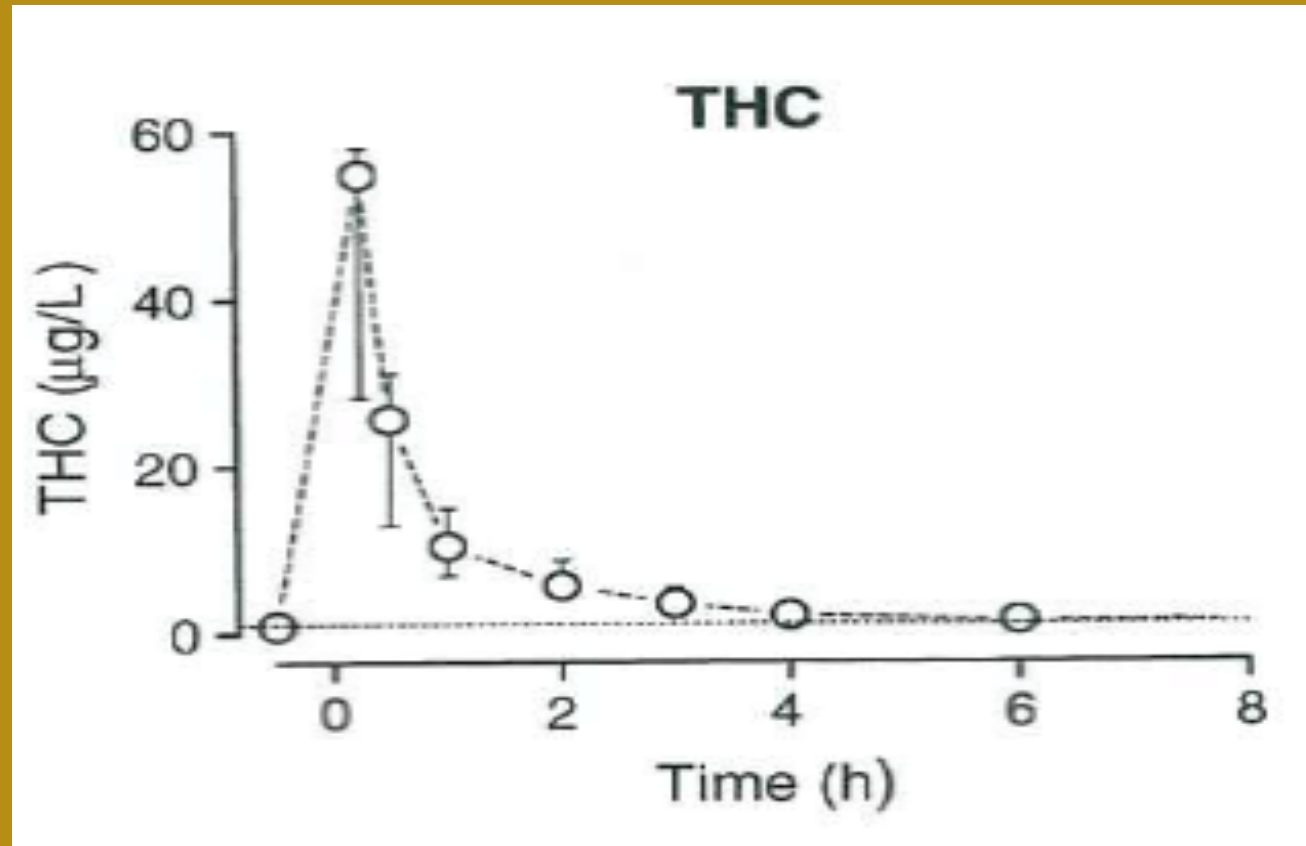
THC Concentrations

- THC concentration in cannabis depends on:
    - Environmental conditions
    - Cultivation techniques

- Cannabis
    - Potency increasing over the years
    - 2010 Study on confiscated cannabis:
    THC 3.4% (1998) → 8.8% (2008)
    - 2012 Albania study: ~12% THC

Metabolism

- THC main metabolites
  - 11-OH-THC (**Hydroxy-THC**)
  - 11-nor-9-carboxy-THC (**Carboxy-THC**)

- Metabolized in the liver

- Lipophilic: stored in fat
  - Brain is fatty
  - Concentrations can be below detectable limits in the blood and still be active in the brain
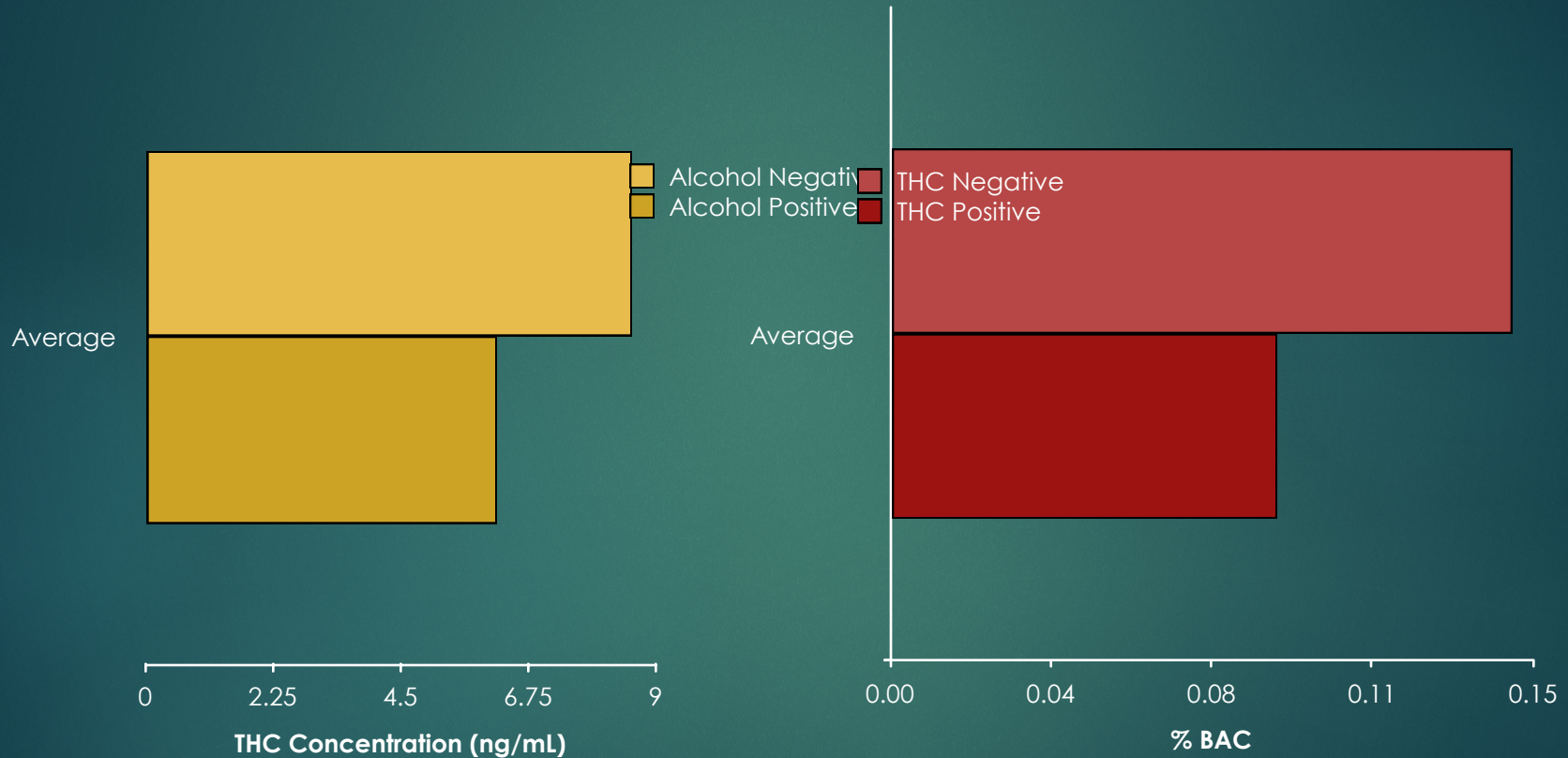
THC

THC (µg/L)

Time (h)

ear

Ingestion vs Smoked

- Smoked
  - Most common route of ingestion
  - Almost immediate exposure to CNS
  - Peak before smoking is finished
- Eaten
  - Longer time to feel effects
  - Longer time to peak in blood
  - Lower peak THC concentrations in blood
  - Prolongation of effects vs smoking
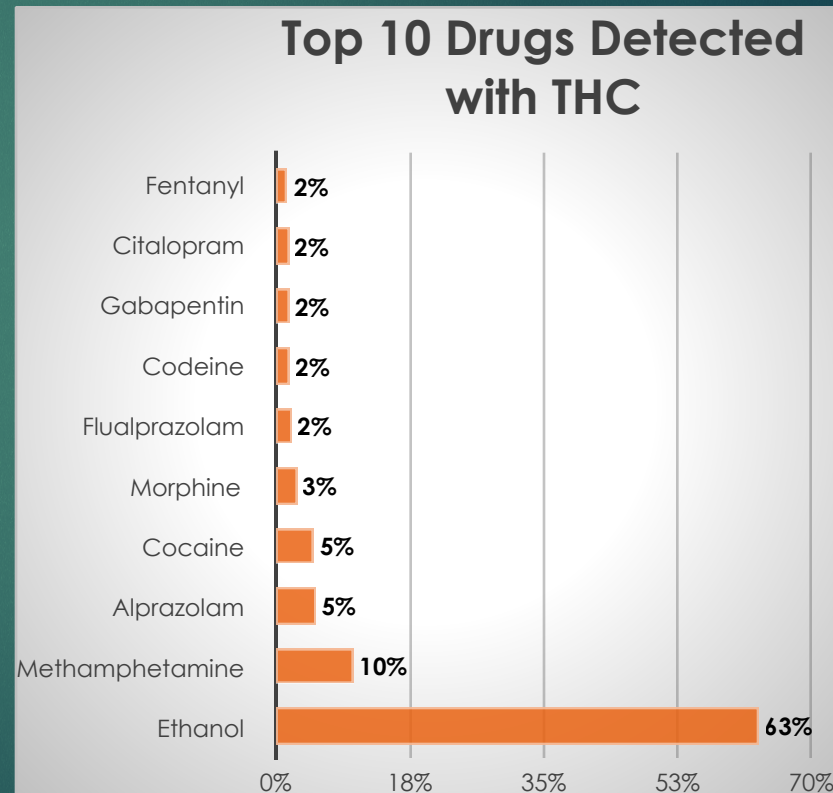
Cannabis Users Titrate Doses

Left chart — THC Concentration (ng/mL), horizontal axis: 0, 2.25, 4.5, 6.75, 9
- Legend: Alcohol Negative, Alcohol Positive
- Category: Average

Right chart — % BAC, horizontal axis: 0.00, 0.04, 0.08, 0.11, 0.15
- Legend: THC Negative, THC Positive
- Category: Average

THC is rarely the only drug detected

- 82% of THC positive samples test positive for another impairing substance

Top 10 Drugs Detected with THC

Drug	Percentage
Fentanyl	2%
Citalopram	2%
Gabapentin	2%
Codeine	2%
Flualprazolam	2%
Morphine	3%
Cocaine	5%
Alprazolam	5%
Methamphetamine	10%
Ethanol	63%

Effects

Depressant

Hallucinogen

Stimulant

Synergistic + 🍺 = 🍷🍸🥃

Effect

Field Sobriety Tests & DRE

- THC concentrations cannot be correlated to specific impairment

- Field Sobriety Tests are sensitive for THC

- Both DREs and non-DREs can sensitively determine impairment from THC

Field Soberity Tests & DRE

- No differences in cases ≥ 5 ng VS ≤ 5ng

- Best to use psychophysical indicators and eye exams

- Longer blood draw times yielded lower THC concentrations

- Results support the cannabis impairment training taught in DECP/DRE

Tolerance and Chronic Use

▶ Individuals can be impaired by THC even after there is no detectable level in the blood

▶ In heavy chronic users, THC can be detected in blood even after a few days of abstinence
  ▶ Below 5 ng/ml

▶ Tolerance to effects of THC can occur
  ▶ Occasional users show more impairment

▶ The more THC in the blood, the more likely the impairment

THC and Driving

- Driving ability is maximally impaired at elimination phase
- Decrease feeling of effects equates to less compensation and more impaired driving
- THC impairs
  - Car control
  - Increases # of obstacles hit
  - Increases deviation of lateral position
  - Impairs tracking ability
  - Increases # of sideway movements of car
  - Increases % of time spent outside of lane

Crash Risk

THC (ng/mL)	Author(s)	Odds Ratio (Risk)
< 1.0	Hunter et al.	0.35
1.10-2.0	Hunter et al.	0.51
>2.0	Hunter et al.	1.74
1-100 (median = 10)	Drummer et al.	2.7
5-100	Drummer et al.	6.6
0.05% + THC	Williams et al.	8.6
0.05% + THC	Terhune et al.	8.4
0.05% + THC	Drummer	5.3
0.05% + THC	Hunter et al.	11.5
0.05% + THC	Lowenstein and Koziol	3.5

Alcohol (Drug Free)	Author(s)	Odds Ratio (Risk)
0.05% BAC	Terhune & Fell	5.4
0.05% BAC	Williams et al.	5.0
0.05% BAC	Terhune et al.	5.7
0.05% BAC	Drummer	5.5
0.05% BAC	Hunter et al.	6.8
0.05% BAC	Lowenstein & Koziol	3.2
0.05% BAC	Drummer et al.	6.0

The Data

Current Initiatives

- CHP Cannabis Grant
  - Automated Platforms
  - THC Extraction Redundancy
  - Reduce Turnaround time
- CA OTS Grant
  - In Laboratory Oral Fluid Screening
  - Cannabis and other drugs

# Training

- Hard Science Degree

- Literature Review

- Hands-on Analytical Experience

- Field Observations

- Pharmacology & Analytical Chemistry Academic Coursework

- Testimony Observation & Moot Court

- SFST & DRE

- Controlled Studies

- Postmortem Case Management

Can cannabinoids cause impairment?

- Epidemiology studies
  - Car crash statistics
  - DUI arrest statistics
- Laboratory studies
  - Skills related to driving
- Driving studies
  - Driving simulators
  - Closed driving courses
  - Real highway driving
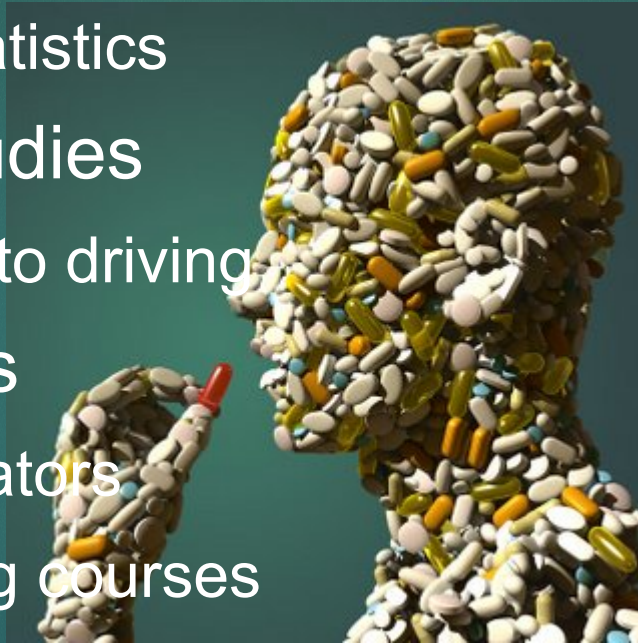
Analysis Testimony

- What drug was found?
    - Brand name, scientific name
    - Instrumentation/method
- General signs/symptoms of drug
- Half-life
    - How long will it stay in the body?
    - How long would crime lab be able to detect in sample the sample?

Impairment Testimony

- Provide testimony on symptomology
  - What should happen when an individual has a particular drug or drugs in their system?
  - How these symptoms could affect driving and FSTs
  - Drug combos
- How do FSTs relate to driving
- We use the "totality of evidence" to form an opinion that individual is consistent with impairment
  - DRE evaluations
  - DUI investigations and observations
  - What drugs were found in the blood sample?

Testimony Data

- DUID accounts for over 30% of all DUI jury trials

- 63% of all DUID jury trials involve cannabis

DUI Jury Trials
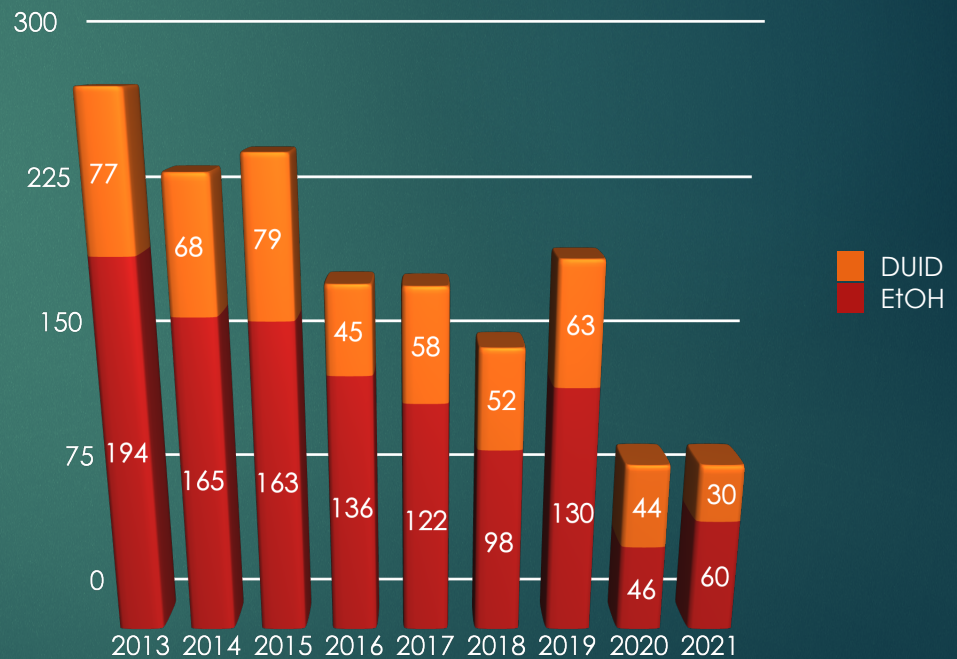
Acknowledgements and Contact Info

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