OVERVIEW OF DRUG EFFECTS ON DRIVING PERFORMANCE

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Customers at a store in Butte, Montana called police to report a sleeping man behind the wheel of the running car around 2:30 a.m.
The officer who responded woke the man up and noticed odd behavior.

"He was confused. His actions were consistent with somebody who might be under the influence of something," the officer reported.
The man denied drinking, gave different stories about where he had been and at one point told the officers he had taken prescription medication to help him sleep.
The man failed a field sobriety test and would not perform others. The officers brought him to jail, where he refused a test to determine his blood alcohol level.
At that point, he was charged with driving under the influence, which is a misdemeanor.
The accused – former U.S. Navy SEAL Robert O’Neill – the man who reportedly fired the shots that killed Osama bin Laden
• Impairment has been typically related to driving performance while using alcohol

• SFSTs are used for drugs but no research to support such use
PER SE CONCENTRATION

• Correlate a level of drug in a physiological fluid with a known set of behavioral criteria which are deemed suggesting impairment

• A level of 0.08 g/dL (0.08 g%) has been codified as the per se concentration for alcohol
HOW IS IMPAIRMENT DEFINED?

EXCUSE ME SIR... MAY I SEE YOUR PAPERS PLEASE?

SORRY OFFICER... I JUST USED 'EM ALL...
EFFECT OF DRUGS ON DRIVING PERFORMANCE IS NOT AS CLEAR

Epidemiology Studies have classical been used to assess relationship between drugs and driving performance.
EFFECT OF DRUGS ON DRIVING PERFORMANCE IS NOT AS CLEAR

Five Types of Epidemiology Studies Used:
1) Reanalysis of blood specimens positive for alcohol
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Five Types of Epidemiology Studies Used:

2) Screening of blood specimens from drivers injured or killed
Screening for drugs in fatal crashes

Figure 3. Trends in drugs used as a percentage of all drugged drivers involved in fatal motor vehicle crashes, by drug type and year: U.S., 1993–2010

- Cannabis
- Cocaine
- Methamphetamine
- Other Schedule I
- Other Schedule II-V


%: 0, 10, 20, 30, 40, 50

*Cocaine and methamphetamine are excluded from the other Schedule II-V category.


Screening for drugs in fatal crashes

Figure 4. Trends in prescription drugs used by drugged drivers in motor vehicle crashes, as a percentage of all prescribed drugs tested, by drug and year: U.S., 1993–2010*  


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Five Types of Epidemiology Studies Used:

3) Roadside surveys
4) Retrospective analysis of driver interviews
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Five Types of Epidemiology Studies Used:

5) Case Control Analysis of Accidents
LABORATORY ANIMALS CANNOT BE USED TO PERFORM DRIVING STUDIES
EFFECT OF DRUGS ON DRIVING PERFORMANCE IS NOT AS CLEAR

Performance Test Studies:

- Simulations (driving simulators)
- Real on-the-road driving
Focus on two parameters in urban, interstate, and rural driving

• Lane keeping
• Speed measures
Cannabis effects on driving lateral control with and without alcohol

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PARTICIPANTS

• 13 males
• 6 females
• Mean age 26.1 ± 4.1 SD
METHODOLOGY

- Six alcohol/cannabis sessions
- Each session separated by ≥ 1 week
ALCOHOL SESSIONS

• Drank alcohol (90%) in fruit juice to achieve 0.065 g/dL BrAC peak

• Drank placebo alcohol – fruit juice containing 1 mL of alcohol to mimic taste and smell

ad libitum over 10 min
CANNIBIS SESSIONS

- Inhaled 500 mg placebo
- Inhaled 500 mg 2.9% THC - Low dose
- Inhaled 500 mg 6.7% THC - High dose

ad libitum over 10 min
CANNIBIS SESSIONS

- University of Iowa is a smoke-free campus
- Cannabis vaporized using a Volcano® Medic
Volcano® Medic
SIMULATED DRIVES

- Drinking occurred first
- Cannabis inhalation done next
- Driving occurred 0.5 to 1.3 hrs after start of cannabis inhalation
- Blood collections at 0.17, 0.42, 1.4, and 2.3 hrs post-inhalation
SIMULATED DRIVES DATA

• Data of one participant excluded

• **Standard Deviation of Lateral Position (SDLP) used**

• **General Linear Model (GDL) from SAS v9.4 used to fit data**
<table>
<thead>
<tr>
<th>THC (µg/L)</th>
<th>BrAC (g/210 L)</th>
<th>Median [range] predicted SDLP (cm)</th>
<th>Difference (cm)</th>
<th>Percent increase(^a) (%)</th>
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<tr>
<td>0</td>
<td>0</td>
<td>31.4 [24.7–44.8]</td>
<td>–</td>
<td>–</td>
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<tr>
<td>1</td>
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<td>0.26</td>
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<td>5</td>
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<td>1.3</td>
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<tr>
<td>7</td>
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<tr>
<td>10</td>
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<td>1.204</td>
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<tr>
<td>20</td>
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<tr>
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<td>0</td>
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<td>0.84</td>
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</tr>
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Hartman, et al. Drug Alc Dep 154:25-37, 2015; Cannabis effects on driving lateral control with and without alcohol
Fig. 2. GLM Select modeled standard deviation of lateral position (SDLP) versus blood $\Delta^9$-tetrahydrocannabinol (THC) concentration (lower x-axis) and versus breath alcohol concentration (BrAC, upper x-axis). Note x-axis scales are different so slopes cannot be directly compared; dotted lines indicate THC concentrations producing equivalent SDLP to 0.02, 0.05, and 0.08 g/210 L BrAC.
HARTFORD HOSPITAL AND THE UNIVERSITY OF IOWA DID A STUDY AND FOUND THAT MARIJUANA USE HAD LITTLE EFFECT ON DRIVING SKILLS.

SO LET'S GO!

I CAN'T FIND MY KEYS!
EFFECT OF DRUGS ON DRIVING PERFORMANCE IS NOT AS CLEAR

Problems With Performance Test Studies:

- Generally young subjects used
- Drug has greater effect on a person not using it for a therapeutic purpose
DRUGS MAY HAVE ACTIVE METABOLITES

• Alcohol does not have metabolites that are of concern for behavioral effects

• Drugs may have metabolites of concern for behavioral effects
EXAMPLE OF DRUG BIOTRANSFORMATION

Prodrug Marijuana ➔ Active (Parent) Drug THC ➔ Active Metabolite 11-OH-THC ➔ Inactive Metabolite 9-CO₂H-THC ➔ Conjugate

Phase I ➔ Phase II

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Drugs other than alcohol have not been assigned *per se* concentration levels, rather it is inferred that if the drug is present and has Central Nervous System (CNS) effects; the individual was under the influence of the drug.
• Labs are in essence setting *per se* concentrations for drugs when the mere presence can be established

• Labs are using the Limit of Quantitation (LOQ) for reporting a drug
PROBLEMS ASSOCIATED WITH REPORTING LOQ

• Concentration reported may have no physiological or pharmacological meaning
• *Per se* concentration needs to be established by COMPETENT expert testimony based upon previous scientific and medical literature and finding of other drugs (synergism) in a tested specimen
Items that should be considered by an expert in addition to lab results:

- Medical records
  - Medical intervention prior to blood specimen collection
  - Type and time specimen collected
  - Correlations with hospital tests
Items that should be considered by an expert in addition to lab results:

- Pharmacy dispensing records
  - Drugs that might suggest an underlying medical condition
  - Confirmation person is regularly taking drug
  - Chronicity of drug use (tolerance)
Items that should be considered by an expert in addition to lab results:

- Police narrative and SFSTs
  - Were HGN clues observed that were impossible for drug reported
  - Report of behavior not associated with the reported drug(s)
Items that should be considered by an expert in addition to lab results:

- Original peer-reviewed scientific and medical literature
  - Has reported behavior ever been associated with reported drug(s)
  - Are reported levels consistent with acute or chronic dosing
SUMMARY

• Detecting impaired motorists uses NHTSA derived driving cues

• *Per se* alcohol levels established but drugs are not (with some State exceptions)
SUMMARY (continued)

• Other forensic evidence must be evaluated along with laboratory results
“CAVEAT INTERPRETOR! As man does not live only by bread, so the toxicologist cannot interpret his results by numbers alone...”