Marijuana and Driving

- Old drug with many challenges (old and new)
- Understanding / recognizing impairment is critical
- Expanded roadside detection training needed
- Additional research needed
- Additional data needed

“Drug Recognition Expert (DRE) Examination Characteristics of Cannabis Impairment”

Accident Analysis and Prevention
April 2016
Hartman, Richman, Hayes, and Huestis

DRE Cannabis Case Study

- 302 Cannabis only DRE evaluations analyzed
- Delta-9-THC blood toxicology cases only
- No other drugs or alcohol involved or reported
- Identified driving actions and impairment indicators
- Examined above and below 5 ng/mL THC cases
- DRE reports collected from nine states:
  AZ, CA, CO, MT, NM, PA, TX, WA, WI
DRE Cannabis Case Study

- Delta-9-THC blood ranges: 1.0 to 47.0 ng/mL
- Mean THC level: 8.1 ng/mL
- 114 cases below 5 ng/mL THC (38%)
- 188 cases at 5 ng/mL THC and above (62%)
- Average age of case subjects: 23.9 years
- White males largest group (58%)

Study Objectives

- Determine if cannabis impairs psychomotor and cognitive performance using actual DRE evaluations
- Determine if there is a relationship between performance impairment and cannabis blood levels
- Corroborate the major and general cannabis impairment indicators used in DRE training
- Identify other cannabis impairment indicators
- Publish the findings

DRE 12-Step Protocol

1. Breath Alcohol Test
2. Interview of the Arresting Officer
3. Preliminary Examination
4. Eye Examinations
5. Divided Attention Psychophysical Tests
6. Vital Signs
7. Dark Room Examinations
8. Examination for Muscle Tone
9. Check for Injection Sites
10. Subject's Statements and Other Observations
12. Toxicological Examination

DRE Evaluation Criteria Used

- Modified Romberg Balance
- Walk and Turn
- One Leg Stand
- Finger to Nose
- Vital Signs (Pulse, B/P, Body temperature)
- Pupil size (RL, NTD, DL)
- Eye indicators
- Reason for the traffic stop and arrest
Marijuana Effects On Driving

Marijuana and Speed

Nation’s first marijuana and driving study (1969) found that using low dose THC levels, monitoring speed was a problem with drivers that used MJ.


Reason for the Traffic Stop

72% of cases involved one or more moving violations. DTD – Disobeyed Traffic Device

Marijuana and Speed

Weaving – Standard Deviation of Lateral Position (SDLP)

- 2nd most described driving indicator in study
- Identified in numerous MJ and driving studies
**Modified Romberg Balance Test**

**Modified Romberg Balance Test Study**

**IACP- DRE Section:**

Jack E. Richman, OD  
October 2010 ©

Modified Romberg Balance on normal non-impaired persons (N=200)

Modified Romberg Balance on impaired persons from different drug categories using retrospective data from DRE evaluations with confirmed toxicology (N=398)

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**Modified Romberg Balance Clock**

Less than 50% were beyond +/- 5 seconds

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**Cannabis Modified Romberg Balance**

Less than 50% were Beyond +/- 5 Seconds
**Modified Romberg Balance**

- The time estimation of 30 seconds plus/minus 5 seconds for normal non-impaired subjects is supported by these studies.
- Performance outside this range must be used cautiously and considered with **ALL the divided attention tasks and observations** that are standardized as part of the **t Totality of the decision process**.

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**Walk and Turn Test Clues**

<table>
<thead>
<tr>
<th>Number of Clues</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7/8</th>
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</thead>
<tbody>
<tr>
<td>Percent</td>
<td>12.7</td>
<td>6.7</td>
<td>27.0</td>
<td>22.7</td>
<td>16.3</td>
<td>9.3</td>
<td>4.3</td>
<td>1.0</td>
</tr>
</tbody>
</table>

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**Walk and Turn Test Clues**

- Too Soon: 9.0
- Lose: 34.3
- Stop: 41.4
- Heel: 41.1
- Off Line: 29.7
- Arms: 43.7
- Steps: 21.3
- Turn: 57.3

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**One Leg Stand Test Clues**

- Left:
  - Sway: 77.3
  - Arms: 77.3
- Right:
  - Sway: 33.0
  - Arms: 37.3
  - Hops: 9.3
  - Foot: 17.7
  - Tremors: 63.7
  - 18.0
Finger to Nose Test and Presence of Tremors

<table>
<thead>
<tr>
<th>Class</th>
<th>Finger to Tip of Nose Misses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 0</td>
<td>12.1%</td>
</tr>
<tr>
<td>Class 1</td>
<td>10.1%</td>
</tr>
<tr>
<td>Class 2</td>
<td>2.0%</td>
</tr>
<tr>
<td>Class 3</td>
<td>1.7%</td>
</tr>
<tr>
<td>Class 4</td>
<td>1.0%</td>
</tr>
<tr>
<td>Class 5</td>
<td>2.0%</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Tremors</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyelid</td>
<td>85.7</td>
</tr>
<tr>
<td>Body</td>
<td>30.7</td>
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<tr>
<td>Both</td>
<td>27.7</td>
</tr>
<tr>
<td>None</td>
<td>11.3</td>
</tr>
</tbody>
</table>
**Vital Signs**

**B/P, Pulse Rate and Temperature**
- **Blood pressure mean**: 135 / 80
  (DRE average range: 120 – 140 / 70 – 90)
- **Pulse rate mean**: 91, 93, 90 Bpm
  (DRE average range: 60 – 90 Bpm)
- **Body temp mean**: 97.2 degrees
  (DRE average: 98.6 ± 1 degree)

**Eye Indicators**
- HGN
- Dilated pupils
- Red, bloodshot eyes
- Rebound dilation
- Lack of Convergence

**Cannabis Effects on Autonomic Nervous System**

**AUTONOMIC NERVOUS SYSTEM**

Selective **anticholinergic** activity
Interferes with Para sympathetic System (Vagus Nerve)

**SYMPATHETIC System INCREASE**
- Pupils may be Dilated
- Focusing may be Decreased affecting Lack of Convergence
- Pulse rate increased → Tachycardia
- Blood Pressure Increase
This study replicated an earlier study of unimpaired pupil sizes utilizing the DRE protocol (Richman et al., 2004)

**Pupil Size – Direct Light**

- Percent: 63.0, 37.0

**Eye Indicators**

- Over one-third were Dilated

- Number of Eye Cues:
  - Normal, Droopy, Reddened, Watery, Bloodshot

**Number of Eye Cues**

- >95% had visible Eye Cues

**Eye Indicators**

- HGN and VGN
The uniqueness of this test
DRE Examination Characteristics of Cannabis Impairment, Richman and Hayes

**Eye Indicators**

**Lack of Convergence**

**Lack of Convergence**

**Relationship of Pupil Size and Rebound Dilation**

- NTD Pupil Size:
  - Pupil size NTD < 0.6 mm
  - Pupil size NTD > 0.6 mm

- Rebound Dilation:
  - Present
  - Absent

- Control non-impaired
- Marijuana impaired

**Relationship of Pupil Size and Rebound Dilation**

- Rebound Dilation and DL Size:
  - Pupil size DL < 0.6 mm
  - Pupil size DL > 0.6 mm

- Direct
  - Absent
  - Present
  - 21.2%

- 78.8%
Eye Indicators

Lack of Convergence, Pupil Size, and Rebound Dilation

Are They Related?

Over 76% of Marijuana Cases Exhibited Rebound Dilation and Lack of Convergence
**Pupil Size (Direct Light) and LOC**

**Eye Indicators**

Comparison of Change in Pupil size from NTD and DL

A Clue To Impairment?
**A Clue To Impairment?**

Control (3.5 mm Difference)

- 6.5 mm NTD
- 3.0 mm DL

Less than 2.5 mm Difference in Pupil Size from NTD to DL

This is only a 30% reduction in pupil size constriction during DL

Impaired

- Less than 2.5 mm

**Another Clue to Impairment**

Control (Normals) < 7% had less than a 2.5 mm change

Impaired >43% had less than a 2.5 mm change

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**Dilated Pupils: Effect on Driving**

Pupil dilation influences safe driving. Dilated pupils can interfere with certain aspects of driving and vision performance (e.g., trouble seeing in light that is too bright)

Cannabis adds psychomotor and cognitive effects on top of the dilated pupil affect on FOCUSING and CONVERGENCE

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**Role of Toxicology Results in the DEC Program**

Above – Below 5 ng/ml
Reason for Traffic Stop

Five reasons that occurred more below 5 ng/ml

Walk and Turn Test Clues

One Leg Stand Test Clues

Above – Below 5 ng/ml
Limitations and Strengths in this Present Study

Control Subjects:
- Toxicology screening/testing
- Different demographics from impaired

All impaired cases constituted correctly identified cannabis impairment by DREs in “real-world” evaluations supported by toxicology

Study Conclusions

No significant differences detected in outcome measures between cases with <5 ng/mL and >5 ng/mL THC blood levels.

Combined observations on psychophysical and eye examinations produced best indicators of impairment.

Case study impairment indicators support DRE curricula.

Questions - Comments

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