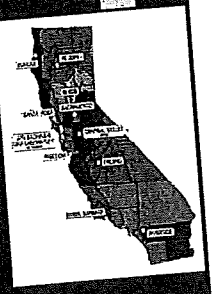
Forensic Alcohol Analysis

CA DOJ BFS REDDING LABORATORY

DOJ Redding Lab

- Lassen
- Modoc
- Siskiyou
- Tehama
- Trinity
- Glenn
- Plumas
- Sierra
- Yuba
- Shasta
- National Parks/Monuments:
  - Lassen
  - Lava Beds
  - Whiskeytown
- And others outside of these if another BFS laboratory requests our service
- 16 Counties served by DNA



Redding Case Load - 2017

- 1245 Alcohol
- 229 Controlled Substance
- 31 Latent Print
- 495 Physical Evidence of which 444 DNA cases
- 1202 Evidential breath tests
- 1703 Screening breath tests
- 767 Total lab hours dedicated to court
  - 31 Court appearances for DUI
  - 323 Total hours for DUI
- Analysts are focused but not dedicated to one area
  - 6 DNA analysts
  - 1 Latent
  - 1 Firearms
  - 3 BA/Breath/Drug
- Currently criminalists are actively training in multiple areas:
  - DNA training 15 months
  - Alcohol 6+ months
  - Firearms 2 years

Lab Accreditation – Quality Assurance

- Our lab is accredited by an outside national accrediting agency...
- ASCLD→ ANSI-ASQ National Accreditation Board (ANAB)
  - **International** Organization of Standardization (ISO)
- Forensic Alcohol Only
  - DPH reviews our procedures and analysis, Title 17
  - Not "licensed" ← old wording

Quality Assurance

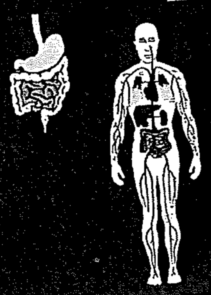
- Inspection every 4 years by external auditors
- Every year the lab and the analysts are "blind" tested
  - Purchased from an external company
  - Results not known until all results are in
  - National participation
- Critical equipment calibrated by approved external company
- Critical reagents provided by approved external company
- Internal QA
  - Every month a portion of the drug/BA cases are retested

DUI - MOU

- Only Fee for Service
  - Analysis of blood, breath, and urine samples for alcohol. The cost of drug analysis in addition to alcohol, when available
  - Provide and maintain breath test instruments
  - Consultation and expert testimony on the technical aspects of all analysis performed including the interpretation of the results relative to driving impairment on cases analyzed by DOJ
  - All of the foregoing services, where necessary, shall be provided by DOJ to the location for an all-inclusive uniform fee of $55.00 per wheel tested. This contract shall apply to all subjects arrested within the County of [—], for violations of 23152 CVC, 23153 CVC, 23103 CVC, and 23140 CVC. Those violations are associated with penalty assessments for laboratory analysis services as specified in the California Penal Code section 1463.14

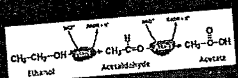
Alcohol in the Body

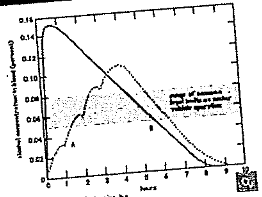
- Absorption
  - Stomach ~25% of alcohol passes into bloodstream
  - Small intestine ~75% of alcohol passes into bloodstream
  - Empty stomach vs full stomach
  - Gastric emptying can delay absorption
  - Average times to peak BAC ~ 30-90 min.
    - Varies per person, many factors to consider
    - Outliers occur
- Distribution
  - Liver, heart and lungs
    - Gas exchange at alveolar sacs in lungs
  - Water loving molecule
  - Higher water content tissues/organs
  - Equilibration between arterial and venous blood
  - Male vs female (average content of water per weight)



Alcohol in the Body

- Elimination
  - Avg. 0.01-0.02%/hour (0.019%/hour more appropriate for apprehended drivers: Jones)
  - Most alcohol consumed (~90%) broken down in liver
  - Small fraction of the alcohol leaves the body unchanged in urine, breath, sweat...
- "Post-absorptive"
  - The rate at which alcohol is leaving the blood (elimination) is faster than that which is entering (absorption) – elimination is occurring when alcohol is present
  - Sometimes, the rates may match each other in a person causing a leveling off of their alcohol content





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Percent of blood alcohol concentration in an average man at hourly intervals after drinking two ounces of spirits each hour for four hours (curve A) and eight ounces all at once (curve B)

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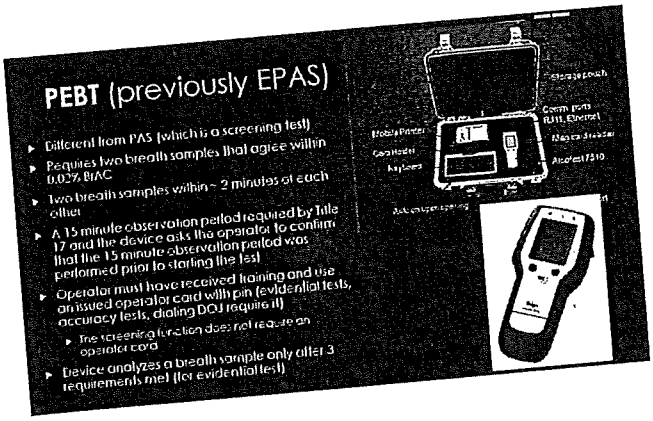
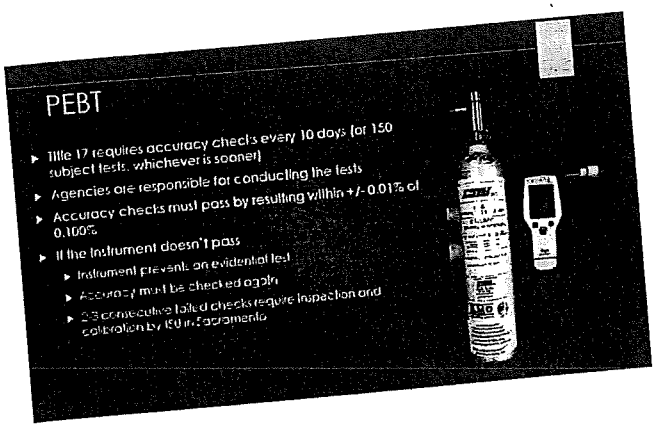
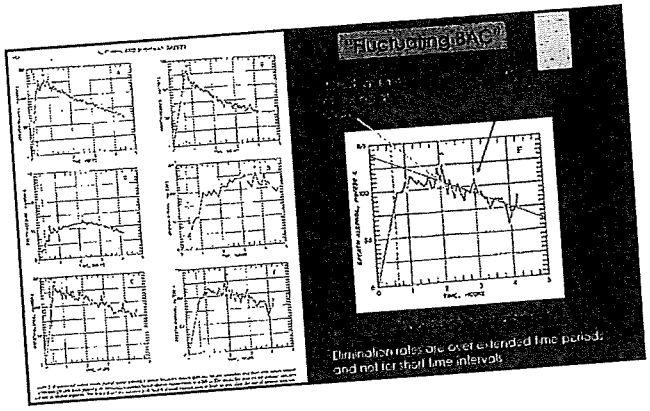
ANY DRUGS OR ALCOHOL?
NO THANKS, I'VE GOT EVERYTHING.


PEBT (previously EPAS)
Different from PAS (which is a screening test)
Requires two breath samples that agree within 0.02% BrAC
Two breath samples within ~ 2 minutes of each other
A 15 minute observation period required by Title 17 and the device asks the operator to confirm that the 15 minute observation period was performed prior to starting the test
Operator must have received training and use an issued operator card with pin (evidential tests, accuracy tests, dialing DOJ requirement)
The screening function does not require an operator card
Device analyzes a breath sample only after 3 requirements met (for evidential test)


PEBT
Title 17 requires accuracy checks every 10 days (or 150 subject tests, whichever is sooner)
Agencies are responsible for conducting the tests
Accuracy checks must pass by resulting within +/- 0.01% of 0.100%
If the instrument doesn't pass
Instrument prevents an evidential test
Accuracy must be checked again
3 consecutive failed checks require inspection and calibration by ISD in Sacramento



Drink # Calculations

- Based on Widmark formula

$$BAC = \frac{\text{Alcohol consumed } (in\ grams)}{\text{weight } (in\ grams) \times \text{Volume distribution } (by\ gender)} \times 100$$

In the original formulas, the volume distributions of alcohol in the blood by gender were fixed values. One value (0.68) was used for males, and another value (0.55) was used for females.

$$BAC = \frac{\left[(\#\ oz\ EtOH\ drink)(\%EtOH\ drink)\left(\frac{29.57\ ml}{1\ oz}\right)\left(\frac{0.789\ g}{ml}\right)\right]}{\frac{p\ L}{kg}(\text{subject wt. lbs})\left(\frac{kg}{2.2\ lb}\right)\left(\frac{10\ dL}{L}\right)}$$

Where p = 0.68 male or 0.55 female

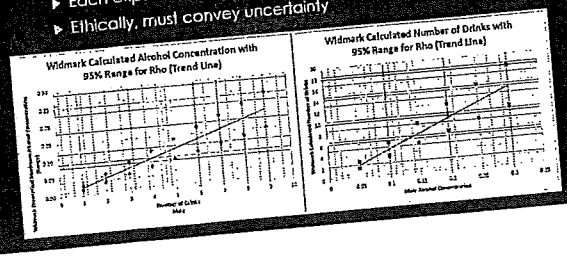
Assumptions in Drink # Calculations

"How many standard drinks are in the body at X % BAC?"

- Average 150 lb. male
- "standard drink"
- Avg. max absorption of ~ 0.02% per drink
- "STILL NOT SPECIFIC TO ANY INDIVIDUAL"
- This is not the same as asking "How many drinks would it take to reach X % BAC?" ← requires a drinking period hypothetical and more assumptions concerning absorption

Widmark – Expert Opinions

- Some will not provide Widmark calculation testimony
- Each expert will have their own opinion and reasons
- Ethically, must convey uncertainty

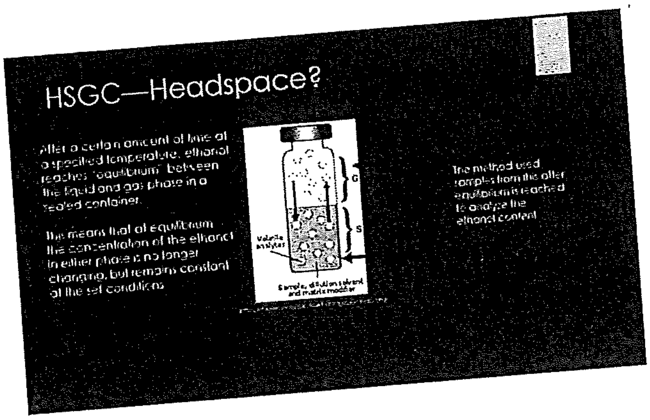


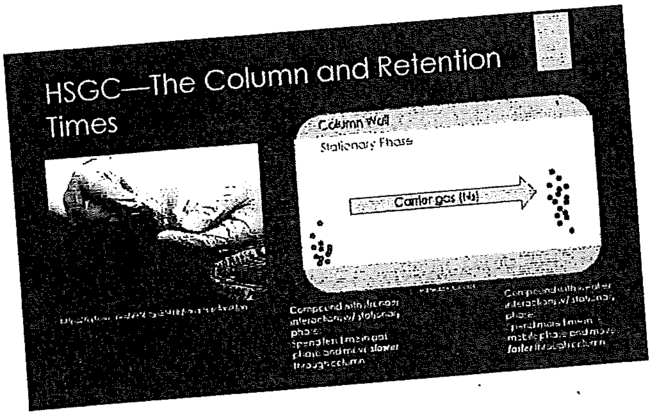
Reliable?

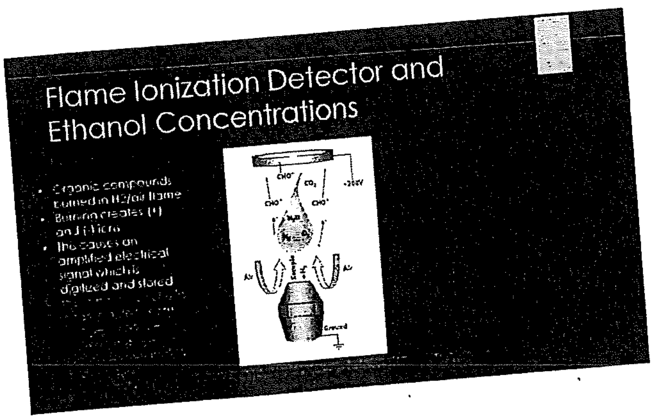
- Can be in a controlled setting
- Differences of opinion on its application in the courtroom
  - Many nationally/international experts in the field do not encourage the practice
- Unreliable data
  - Weight from driver's license
  - Drinking pattern from the defendant's (impaired?) memory
  - Widmark uses "average person"
  - Physiology and food can affect absorption
- Exculpatory evidence – could a certain hypothetical put them below an 0.08% at the time of driving?

Limitations

- It is important to understand the limitations of such calculations, especially when being used in the criminal justice system
- What we rely upon and is known to us with reasonable scientific certainty is our analytical result of the sample at the time of analysis.


HSGC—Headspace?
After a certain amount of time at a specified temperature, ethanol reaches "equilibrium" between the liquid and gas phase in a sealed container.
This means that at equilibrium the concentration of the ethanol in either phase is no longer changing, but remains constant at the set conditions
G
S
Volatile analytes
Sample, dilution solvent and matrix modifier
The method used samples from the after equilibrium is reached to analyze the ethanol content


HSGC—The Column and Retention Times
Column Wall
Stationary Phase
Carrier gas (N2)
Compound with the most interactions w/ stationary phase: spend less time in gas phase and move slower through column
Compound with weaker interactions w/ stationary phase: spend more time in mobile phase and move faster through column


Flame Ionization Detector and Ethanol Concentrations
Organic compounds burned in H2/air flame
This causes an amplified electrical signal which is digitized and stored
CO2
CHO+
Air
Ground

Reported Results

- BAC % (w/v)
  - grams of ethanol per 100ml of blood
- Urine sample results reported after a calculation to account for sample differences ...
- Each case sample is run in duplicate, the truncated average of both results is reported
  - Along with an estimated measurement uncertainty

What is Measurement Uncertainty (MU)?

- There is reasonable variation for any measured value
- A tight range of values for which the true value is expected to lie
- Calculated to a certain level of confidence
- BFS estimated measurement uncertainty for FAA calculated at 99.73% confidence
- Currently 4.6% of the measured value
  - Multiply the average result, which is reported, by 0.046 to obtain the MU

Factors influencing MU

- Analytical instrument
- Devices used in entire method
  - e.g. pipet dilutor
- Analyst
- Sample
- Environment
- others

Impairment

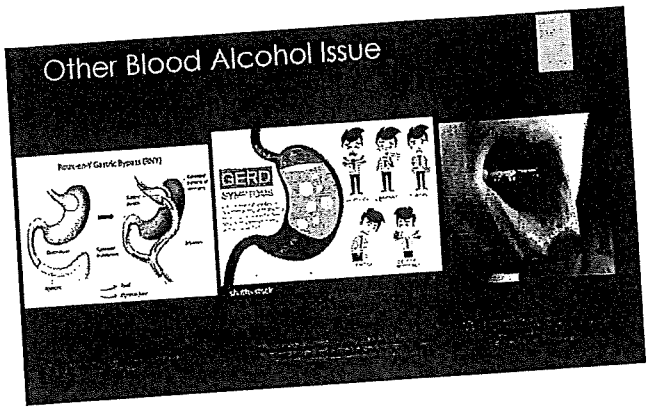
- Theoretically can begin with any departure from 0% BAC
- Mental impairment starts first early on
  - Process and respond to information
  - Memory
  - Slowed reaction
  - Divided attention
  - Decreased inhibition
- Followed by physical impairment as BAC continues to increase
  - Loss of coordination
  - HGN
  - Slurred speech
  - Vomiting
  - Staggering gait
  - Balance
  - Coma/death
- Tolerance
  - Varies
  - Different people can differentially mask physical impairing effects of alcohol
  - Experience with drinking, inherited tolerance

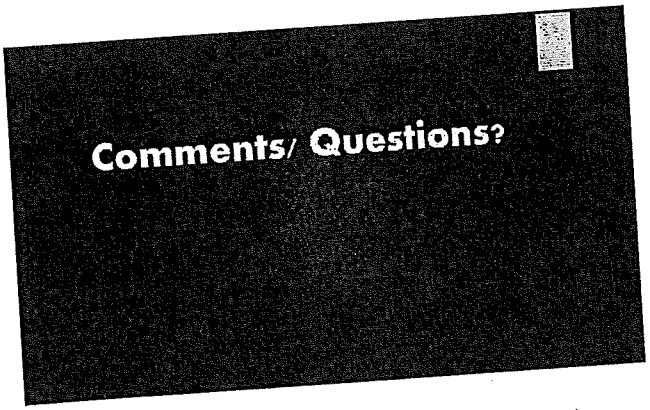
SFSTs

- Set of 3 standard roadside tests validated by NHTSA designed to help the observer/officer screen for impairment due to alcohol
- SFSTs do not assess driving- they help detect if someone is at/above the legal limit
- Criminalists do not perform these and usually have limited experience seeing these conducted

Crash Risk

- From a statistical standpoint, studies have found and shown that as BAC increases, so does the relative risk of collision
- This relationship is exponential according to some findings
  - Holcomb (1938)
  - Lucas et al (1955)
  - McCarroll & Haddon (1962)
  - Borkenstein—Grand Rapids (1974)
  - Hurst et al (1996)
  - Blomberg et al (2009)


Other Blood Alcohol Issue
GERD


Comments/ Questions?