

What Really Works in Alcohol Monitoring



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MADD & NHTSA Statistics



An average drunk driver has driven drunk 80 times before his arrest

50-75% of convicted drunk drivers continue to drive on a suspended license

**Basically drinking and driving sucks.
...and drugged driving isn't any better.**

Almost every 90 seconds, a person is injured in a drunk driving crash

Every day in America, another 28 people die as a result of drunk driving crashes

In 2012, 10,322 people died in drunk driving crashes - one every 51 minutes

Effects of Drugs & Alcohol



Agenda



- Comparison of Alcohol Monitoring Technology

- BrAC - Breath detection
- TAC - Sweat detection
- EtG - Urine detection

“Start with the assumption that the best way to do something is not the way it's being done right now.”

- *Aaron Levie, CEO of Box*

Alcohol Detection



BrAC
TAC
ETG



What Are You Looking For?



- Is a drink or two once in a while allowed?
- How soon do you want to know about a drinking event?
- Is differentiating contaminants from consumed alcohol necessary?
- How important is the cost?

Breath Alcohol Monitor



ALCOHOL CONSUMPTION WINDOW OF DETECTION CONFIRMATION

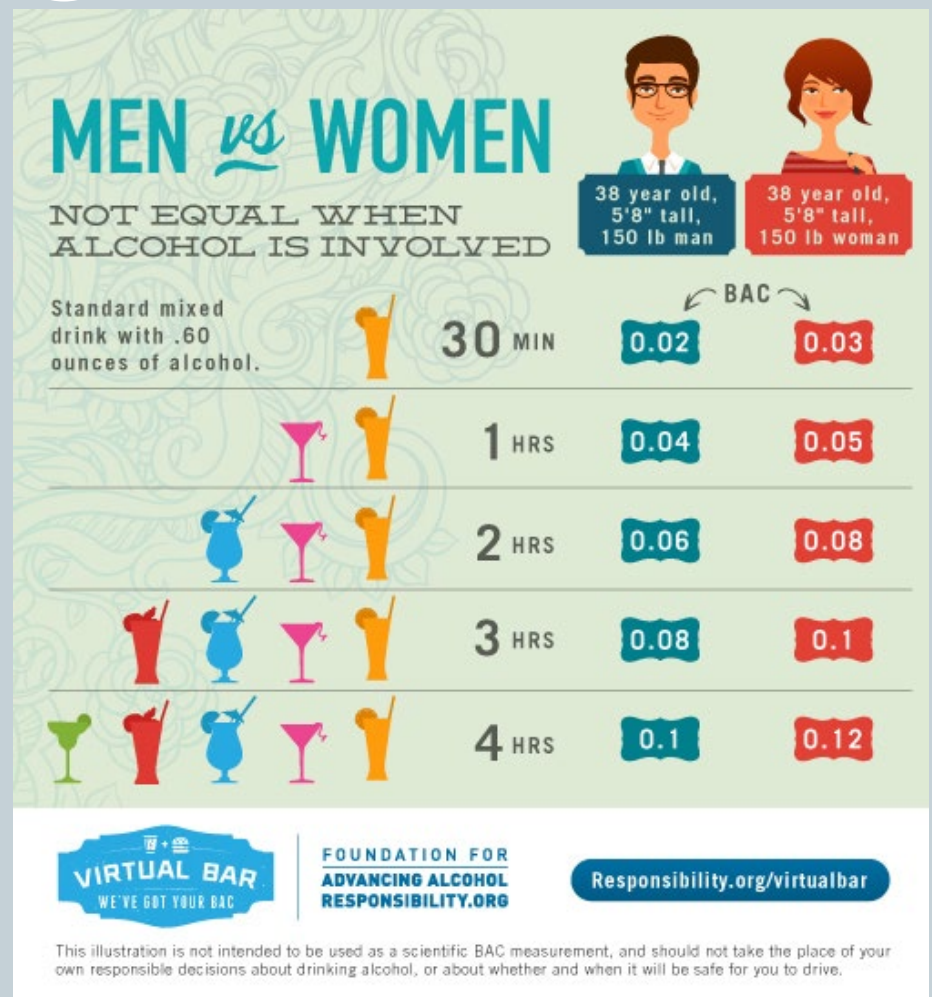


Thanks to her new food-breath analyzer,
Cheryl could find out what her kids
REALLY had for lunch.

Blood Alcohol Concentration (BAC)

Consumption

- Absorption Rate:
 - Increase for 30 min to 2 hrs.
- Elimination Rate:
 - Average .015 .020% per hour

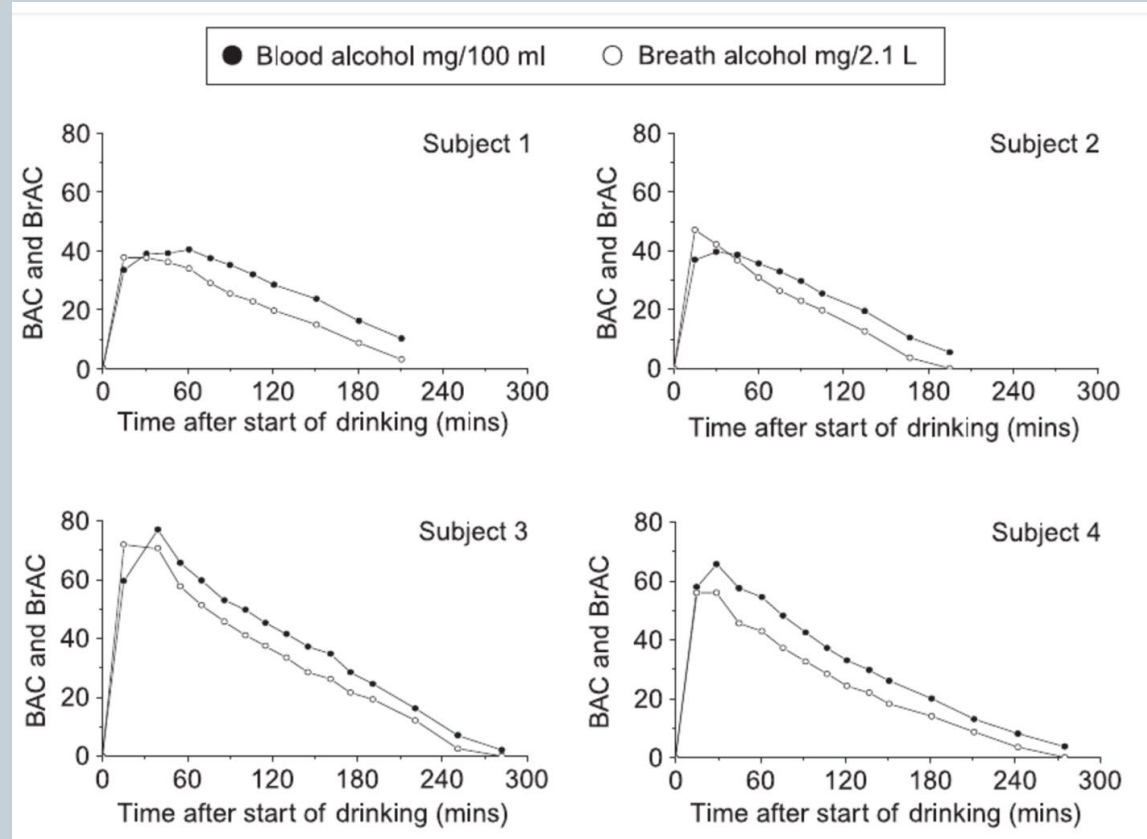


BAC vs BrAC



Detection

- After 15-30 min, blood is higher than breath
- Breath monitors alveolar air



Breath Alcohol Device

Detection

- Fuel Cell
 - BrAC .000 to .600
 - +/- 0.005
 - Breath Volume
 - Temperature
 - Humidity



Breath Alcohol Device

Detection

- Features
 - Battery
 - Camera
 - Cell modem



Breath Alcohol Device

Detection

- Programming
 - Up to 10 tests per day
 - Vary test frequency
 - Custom settings
 - Retest
 - Zero Tolerance



Contaminants

	Listerine Deeper Clean - Mouthwash	Colgate Total Adv. ALCOHOL FREE - Mouthwash	Listerine Freshburst - Strip	Scope Outlast - Breath Mist	Listerine - Pocketmist	Martinelli Cider - ALCOHOL FREE	Monster - Zero Ultra	Monster - Ultra Blue	Red Bull	5 Hour Xtra Strength Berry	Tresemme Xtra Firm - NON-AEROSOL	Tresemme Xtra Firm - AEROSOL
Wait time after product use	30 sec	0	1 minute	30 sec	30 sec	0	0	0	0	0	0	0
BrAC test result	0.189	0.000	0.000	0.103	0.025	0.000	0.000	0.000	0.000	0.000	0.019	0.015
Rinse mouth	no			no	no						no	no
Time between tests	3 min			3 min	2 min						2 min	3 min
BrAC test result	0.125			0.000	0.000						0.000	0.000
Rinse mouth	no											
BrAC test result	0.000											

If you rinse & retest, contaminants disappear.

Wait time												
BrAC test result	0.000	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.006	0.048	0.189
Rinse mouth		no		no	no	no	no	no	no	no	yes	no
Time between tests		3 min		1 min	1 min	0 min	1 min	4 min, 3 swallow	3 min	2 min	2 min	2 min
BrAC test result		0.000		0.000	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.024
Rinse mouth				no	no	no	no	No				no
retest				1 min	1 min	1 min	< 1 min	2 min				4 min
BrAC test result				0.000	0.000	0.000	0.000	0.000				0.000

Breath Alcohol Device

Detection Summary

- Fuel Cell
 - Quantitative
- Temp & Humidity Sensor
 - Accuracy
- Camera
 - Facial Detection
- Cellular Modem
 - On Board
- Robust Programming
 - Qualitative



Breath Alcohol Monitoring



Confirmation

- BrAC
 - Exact reading, closely related to BAC
 - Current state of impairment
 - Automatic re-test after fail
- Zero Tolerance
 - 63% of our violations over a 1 week period were consistent with consumed drinking $<.020$ BAC
- Metabolic Rate
 - Consumed vs Contaminant



Breath Alcohol Summary



- **Alcohol Consumption Levels**
 - 30 min to 2 hours after consumption
 - Elimination of .020% per hour
- **Window of Detection**
 - From .000 to .600 with $\pm .005$ accuracy
 - Multiple tests per day
- **Confirmation**
 - Repeat tests during event
 - Average fail rate .02, Smart Start Wisconsin is .005

Transdermal Alcohol Monitor



**ALCOHOL CONSUMPTION
WINDOW OF DETECTION
CONFIRMATION**



Transdermal Alcohol Monitoring



- Fuel Cell
 - Monitors perspired alcohol,
 - Transdermal Alcohol Concentration (TAC)
- Worn by user
 - No camera or facial detection software needed
- Tests every 30 min
 - No test windows needed
- Pair with base to send data
 - Base unit is not portable
- Battery operated
 - Replace 30-60 days



Transdermal Alcohol Monitoring



Alcohol Consumption

Table 2. TAC-Based and AMS Criteria for the Detection of Drinking Events

	Males					Females					Total
Beers (units) consumed	1 (0.92)	2 (1.84)	3 (2.76)	4 (3.68)	5 (4.60)	1 (0.92)	2 (1.84)	3 (2.76)	4 (3.68)	5 (4.60)	
Total <i>n</i>	32	32	32	32	32	29	29	29	29	17	293
Exceed 0, <i>n</i> (%)	20 (62.5)	30 (93.8)	32 (100)	32 (100)	32 (100)	17 (58.6)	28 (96.6)	29 (100)	29 (100)	17 (100)	266 (90.8)
Exceed 0.02, <i>n</i> (%)	0 (0)	8 (25.0)	24 (75.0)	31 (96.9)	32 (100)	0 (0)	17 (58.6)	23 (79.3)	29 (100)	17 (100)	181 (61.8)
Exceed 0.03, <i>n</i> (%)	0 (0)	4 (12.5)	15 (46.9)	29 (90.6)	32 (100)	0 (0)	11 (37.9)	21 (72.4)	28 (96.6)	17 (100)	157 (53.6)
AMS resolved, <i>n</i> (%)	0 (0)	8 (25.0)	19 (59.4)	30 (93.8)	32 (100)	0 (0)	13 (44.8)	19 (65.5)	29 (100)	17 (100)	167 (56.9)
AMS confirmed, <i>n</i> (%)	0 (0)	8 (25.0)	16 (50.0)	27 (84.4)	31 (96.9)	0 (0)	11 (37.9)	18 (62.1)	28 (96.6)	17 (100)	156 (53.2)

AMS, Alcohol Monitoring Systems; TAC, transdermal alcohol concentration.

Displayed are the number of subjects and the percentage of 32 males and 29 females whose TAC levels were greater than (exceed) various criteria for detection after drinking the designated number of beers (no. beers). Shown also are the number of standard drinks (no. units) contained in each no. beers.

Transdermal Alcohol Monitoring

Alcohol Consumption

- 1 beer = missed 100%
 - ✦ TAC for 62.5% of males exceeded zero
 - ✦ TAC for 58.6% of females exceeded zero
 - 0% Exceeded .02 g/ml & 0% confirmed
- 2 beers = missed 68.5%
 - ✦ TAC for 93.8% of males exceeded zero
 - ✦ TAC for 96.6% of females exceeded zero
 - 41.8% Exceeded .02 g/ml & 31.5% confirmed
- 3 beers = missed 43.9%
 - ✦ TAC for 100% of all exceeded zero
 - 77.2% Exceeded .02 g/ml & 56.1% confirmed



**45.9% of all occasions of drinking 1 to 3 beers
were NOT detected.**

Transdermal Alcohol Monitoring

Alcohol Consumption

- 4 beer = missed 9.5%
 - ✦ TAC for 100% of all exceeded zero
 - 98.5% Exceeded .02 g/ml & 90.5% confirmed
- 5 beers = missed 1.5%
 - ✦ TAC for 100% of all exceeded zero
 - 100% Exceeded .02 g/ml & 98.5% confirmed



Only reliably detects heavy drinking levels of approx. 4 standard drinks for females & 5 for males when consumed in <3 hours.

Transdermal Alcohol Monitoring



Other Alcohol Consumption Studies:

- **2014 Predictors of Detection of Alcohol Use Episodes Using a Transdermal Alcohol Sensor**
 - The SCRAM sensor is very good at detecting five or more drinks
- **2019 Processing transdermal alcohol concentration (TAC) data to detect low-level drinking**
 - Reliance upon the AMS criteria for alcohol detection affords a high specificity for detection of heavy drinking but is a poor indicator of abstinence rates.
- **2020 Wearable Transdermal Alcohol Monitors: A Systematic Review of Detection Validity, Relationship Between Transdermal and Breath Alcohol Concentration and Influencing Factors**
 - SCRAM seems unable to detect low to moderate drinking levels using the thresholds and criteria set by the manufacturer.

Transdermal Alcohol Monitoring



Window of Detection

- Approx. 1-2 Hour Delay After Detectable in BAC
- Pairing Required for Data Upload
 - Not real time detection



Transdermal Alcohol Monitoring



Accuracy & Sensitivity

- Water
- Environmental
- Hygiene Products
- Cold Skin (slows vapor loss)
- Hydration Levels
- Individual Characteristics
 - Sweat rate
 - Skin thickness

NHTSA determined that “a TAC reading of 0.02 g/dl produced a 12.34% false-positive rate with SCRAM devices.”

Transdermal Alcohol Monitoring



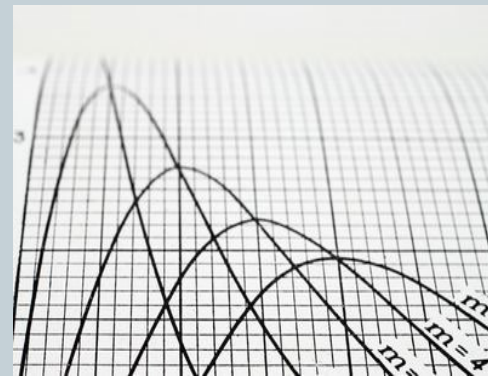
Confirmation

• Algorithm

- Confirmed TAC $>.02$ g/dL
- May require 3 TAC reading of $.02$ or higher
- Different absorption & elimination rate based on peak TAC
- Avoids contaminates and low BAC events

• Spiky at Times

- Water affects accuracy
- Misclassify rapid rise in BAC as an external interferent



TAC Summary



- **Alcohol Consumption**
 - Best for high drinking (5 drinks or more)
 - >0.020 BAC
- **Detection**
 - 1 hr after BAC
 - Sample every 30 min
 - Sends when paired
- **Confirmation**
 - Algorithm
 - Testimony at .02 or .04 depending on vendor

Transdermal Vs Breath Alcohol Monitoring

Transdermal

Accuracy

- .020 g/dL
- Algorithm to Determine BAC
- Contaminants Effect Reading
 - Also Effected by
 - ✦ Water
 - ✦ Cold skin (slows vapor loss)

Delayed Detection

- 1 hr after BAC
- Sample Every 30 Min

Pairing Required for Data Upload

Breath

Accuracy

- .005 BAC
- BrAC Directly Related to BAC
- Retest Clears Contaminants
 - Immediate retest after fail

Immediate Detection

- 30 Min to 2 Hrs Post Drinking
- Scheduled Test Windows

All-In-One Unit

- Real-time Reports
 - GPS Location of Tests

EtG



**ALCOHOL CONSUMPTION LEVELS
WINDOW OF DETECTION
CONFIRMATION**



Ethyl Glucuronide (EtG)

- Alcohol Metabolite Found in Urine
- Observed Collection
 - Instant test (POCT) or lab screen
 - Sample can be screened for multiple drugs
- Everyone is Able to Provide
- Lab Confirmation of EtS



Who May Become A Collector?



- Anyone can be a professional collector

A person trained in DOT policies and procedures to collect urine specimens to be used for drug testing programs

- No medical background is necessary



The Importance of A Professional Collector

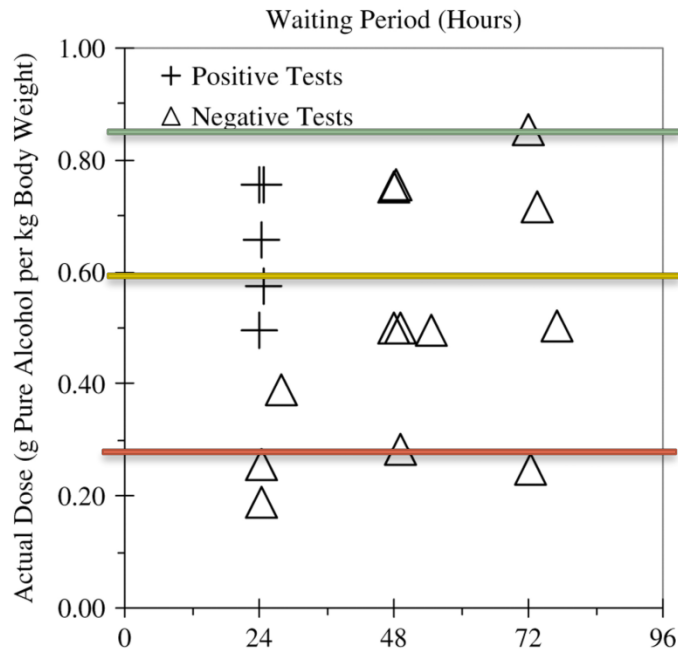


- Ensures the integrity and security of the collection process
- Has direct contact with the donor
- Consistently executes every collection
- Collection process is considered “defensible”



From: **Sensitivity of commercial ethyl glucuronide (ETG) testing in screening for alcohol abstinence**

Alcohol Alcohol. 2007;42(4):317-320. doi:10.1093/alcalc/agm014



High Dose Group

Dose 0.66 to 0.85 = up to 6.4 drinks
= 0.031 to .109 BAC

Medium Dose Group

Dose 0.39 to 0.58 = up to 3.4 drinks
= .032 to .087 BAC

Low Dose Group

Dose of 0.19 to 0.28 = up to 2.4 drinks
= .028 to .034 BAC

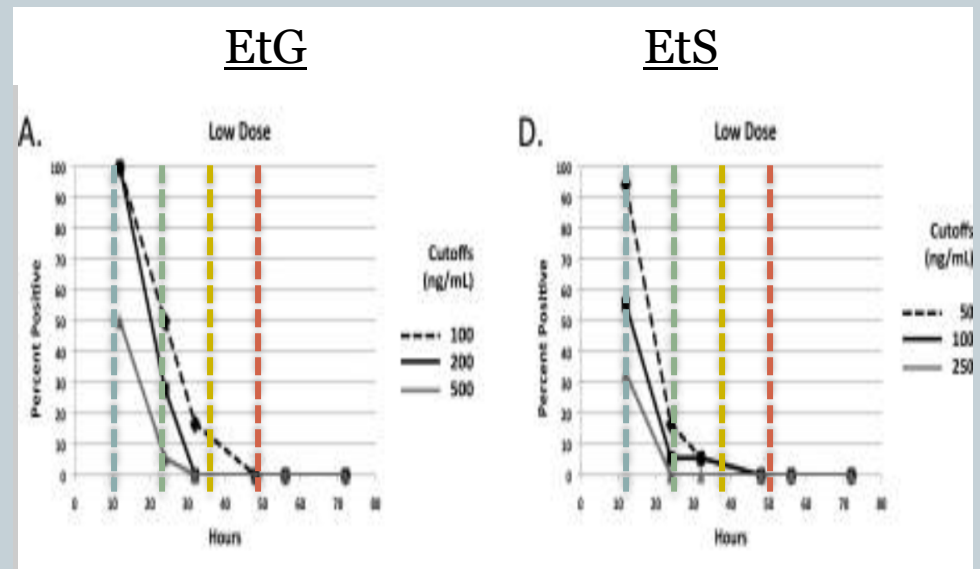
- Individual test results by actual dosage and actual waiting period.
- 100 ng/ml EtG

Ethyl Glucuronide (ETG)

Alcohol Detection

500 ng/ml

- 12 hrs
 - ✦ 50% low dose
- 24 hrs
 - ✦ 5% low dose
- 36 hours
 - ✦ 0% low dose
- 48 hours
 - ✦ 0% low dose



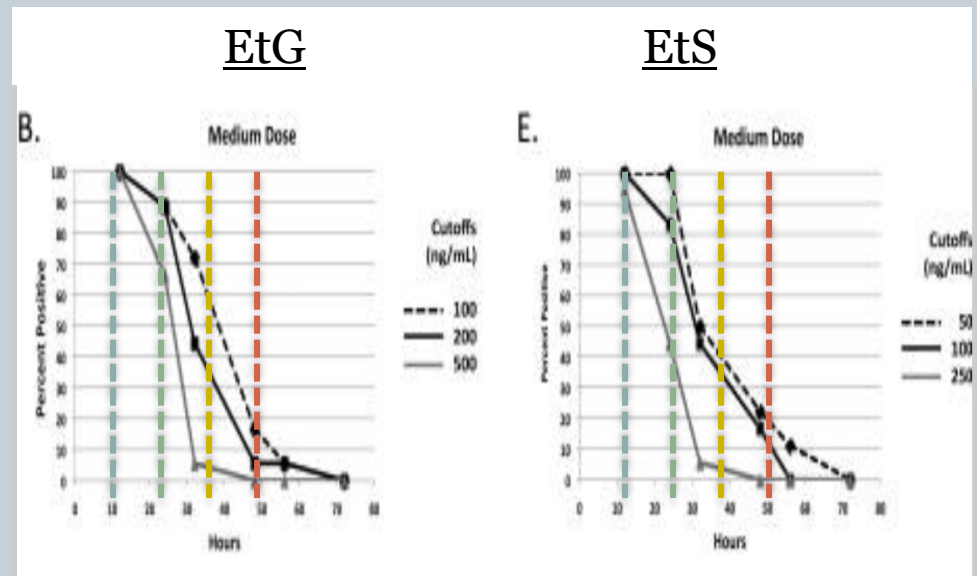
Actual BAC: Low Dose = .028% (20 mg/dl)

Ethyl Glucuronide (ETG)

Alcohol Detection

500 ng/ml

- 12 hrs
 - ✦ 100% med dose
- 24 hrs
 - ✦ 65% med dose
- 36 hours
 - ✦ 5% med dose
- 48 hours
 - ✦ 0% med dose



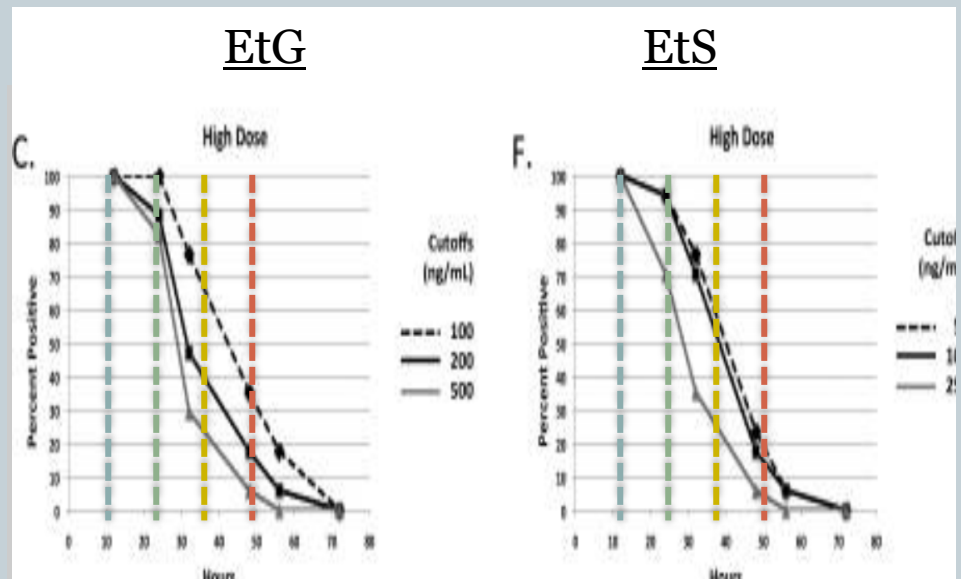
Actual BAC: Med Dose = .093% (80 mg/dl)

Ethyl Glucuronide (ETG)

Alcohol Detection

500 ng/ml

- 12 hrs
 - ✦ 100% high dose
- 24 hrs
 - ✦ 80% high dose
- 36 hours
 - ✦ 25% high dose
- 48 hours
 - ✦ 5% high dose



Actual BAC: High Dose = .138% (120 mg/dl)

EtG Lowered Sensitivity



Alcohol Detection

- **Effected by Contaminants**
 - Medications
 - Hand Sanitizers
 - Hygiene products
 - Antiperspirant
 - Banana (within 3.5 hrs)
 - Sauerkraut (within 5 hrs)
- **Bacterial UTI**
 - False-positive & false-negative results



Confirmation with EtS



Alcohol Detection

- **Few Discrepancies between EtG and EtS**

(2014) Ethyl Glucuronide and Ethyl Sulfate Assays in Clinical Trials, Interpretation, and Limitations: Results of a Dose Ranging Alcohol Challenge Study and 2 Clinical Trials



- **EtS provides a slightly greater sensitivity to alcohol**

(2012) The Role of Biomarkers in the Treatment of Alcohol Use Disorders, 2012 Revision



EtG Summary



- Alcohol Consumption
 - Good for medium to high drinking
- Detection
 - Best within 24 hrs
- Confirmation
 - EtS

EtG vs Breath Alcohol Monitoring

EtG

Accuracy

- Detection varies
- EtS needed to confirm
 - 24-48 hrs to confirm
- Contaminants cannot be cleared

Minimal Detection

- 48 hrs or less

Limited Availability

- Test at facility

Breath

Accuracy

- .005 BAC
- BrAC directly related to BAC
- Repeated test for Confirm
 - Immediate provided
- Contaminants can be cleared

Quick Detection

- 30 min BrAC after drinking

Test anywhere, Anytime

- Real-time reports
- GPS Location of tests

Review of Technologies



EtG vs TAC vs BrAC Monitoring



ETG

Accuracy

- Detection varies
- EtS needed to confirm
 - 24-48 hrs to confirm
- Contaminants cannot be cleared

Minimal Detection

- 48 hrs or less

Limited Availability

- Test at facility

TRANSDERMAL

Accuracy

- .020 g/dL
- Algorithm to determine BAC
- Contaminants effect reading
 - Also Effected by
 - ✦ Water
 - ✦ Cold skin (slows vapor loss)

Delayed Detection

- 1 hr after BAC
- Sample every 30 Min

Pairing Required for Data Upload

BREATH

Accuracy

- .005 BAC
- BrAC related to BAC
- Repeat test to confirm
- Clear contaminants

Quick Detection

- 30 min after drinking
- On Demand or Test Window

Test anywhere, Anytime

- Real-time reports

Cost of Alcohol Monitoring Program



EtG

- \$4-5 Per Test, Every Other Day
 - \$18-25 at a drug testing facility
- EtS/Confirmation is Extra (\$20+)

Transdermal

- \$9-12 Per Day + Enrollment

Breath

- \$2.50-\$6.50 Per Day + Enrollment
 - Breath Check \$2.50 Per Day
 - SMART Mobile \$6.50 Per Day
 - Cellular IID \$4.30 Per Day



Suggested Use For Each Technology



- **Transdermal (TAC)**
 - Phase 1: when heavy drinking is more likely
 - Sanction
- **Breath (BrAC)**
 - Long term or regular sobriety monitoring
 - Phase 1-4
- **Urine (EtG)**
 - Random or in addition to drug panel
 - Last Phase

1st 90 days:
**Transdermal
or Breath**

Throughout Treatment:
Breath

Random:
Urine

What Are You Looking For?



- Is a drink or two once in a while allowed?
 - No? Then a Zero Tolerance program is needed.
 - Breath is best technology for this program.
- How soon do you want to know about a drinking event?
 - Now? Then Real-time Alerts are necessary.
 - Breath is best technology for this program.
- Is differentiating contaminants from consumed alcohol necessary?
 - Yes? Then back to back BAC readings are necessary.
 - Breath is best technology for this program.
- How important is the cost?
 - Breath & EtG are lowest cost.
 - EtG require confirmation which can be costly.

Thank you for your time!



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