What’s New in Drug and Alcohol Testing: New Markers and Devices for Monitoring Participants

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Disclosures

• Director, Promises Professionals Treatment Program – employee
• Affinity Online Solutions – tertiary MRO consultant
• Consultant to numerous regulatory boards, courts, and other agencies
Background

• Innovator of EtG as an alcohol biomarker with Friedrich Wurst MD from Switzerland in 2001
• Assisted the initial lab in the USA, NMS near Philadelphia, to start performing EtG testing
• Participated in both SAMHSA committees that developed Advisories re new alcohol markers in 2006 and 2012
• Accepted as an expert and testified in 46 administrative hearings, 22 criminal, 14 custody, and 1 federal class action suit
• Maintains website: www.ethylglucuronide.com
Peer Review Articles

• Expertise in Alcohol Biomarkers

• Publications
  – Skipper GE, Liepman M, Wurst FM, Weinmann W. Breathing Vapor of Ethanol-Based Hand Sanitizing Gel Vapor Causes Positive Alcohol Marker, Ethylglucuronide (EtG), and Positive Breathalyzer. (Accepted for publication by Journal of Addiction Medicine 11/25/2008)
Peer Review Articles

• Publications Cont’d

  
  
  
  

Overview

• New alcohol biomarkers
  – Standard of care for use
  – To detect drinking and document abstinence
  – Used individually or together to enhance reliability

• New devices for monitoring alcohol use
  – Comparison to biomarkers
  – Used with biomarkers
Standard Use of Alcohol Markers
Survey of all Physician Health Programs (March 2013)

1. All programs use EtG
   – 47% have EtG on a standard panel
   – 53% have EtG on a separate panel

2. 85% use EtS
   – 82% use it because it automatically comes with EtG

3. 76% use blood PEth
   Of those 24% who don’t use it:
   – 50% don’t know why they don’t use it
   – 50% don’t use it because there is not yet adequate science to support its use – 3 programs
Standard Use of Alcohol Markers

4. EtG cutoffs:
   a. 100ng/ml – 7%
   b. 250ng/ml – 34%
   c. 500ng/ml – 57%

5. Reporting of EtG to regulatory board:
   a. Always – 18% - N=8 programs
   b. Depends on circumstances – 58% 25 programs
Standard of Use of Alcohol Markers

7. About ½ of programs have used hair or nail EtG.

8. Most common reasons for use of PEth test
   – 60% After positive EtG/EtS if drinking is denied
   – 63% If drinking is highly suspected
   – 23% of programs use it randomly
<table>
<thead>
<tr>
<th></th>
<th align="left">Please check all that apply regarding your laboratory's EtG testing technique and reporting (Choose all that apply):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td align="left">Although the lab reports EtG ≥ 500, we are much more concerned about values ≥ 1000.</td>
<td>Mar 7, 2013 9:24 PM</td>
</tr>
<tr>
<td>2</td>
<td align="left">There is always an initial screen followed by LC/MS-MS confirmation. All testing done at Quest or LapCorp.</td>
<td>Mar 7, 2013 9:26 AM</td>
</tr>
<tr>
<td>3</td>
<td align="left">If the initial test is positive it is then sent out for confirmation using LC/MS/</td>
<td>Mar 7, 2013 7:49 AM</td>
</tr>
<tr>
<td>4</td>
<td align="left">We use two different labs currently (USDTL and LabCorp)—above is for USDTL</td>
<td>Mar 6, 2013 8:47 PM</td>
</tr>
<tr>
<td>5</td>
<td align="left">we have a different consequence for 250 and above vs 500 and above</td>
<td>Mar 6, 2013 8:27 PM</td>
</tr>
<tr>
<td>6</td>
<td align="left">we do not count unless greater than 500. less than that we just keep a closer look at things</td>
<td>Mar 6, 2013 8:11 PM</td>
</tr>
<tr>
<td>Use Case</td>
<td align="left">Response Percent</td>
<td>Response Count</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td align="left">------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>After a positive EtG or EtS and drinking is denied</td>
<td align="left">60.0%</td>
<td>21</td>
</tr>
<tr>
<td>With assessments when indicated</td>
<td align="left">51.4%</td>
<td>18</td>
</tr>
<tr>
<td>Following participant vacations</td>
<td align="left">40.0%</td>
<td>14</td>
</tr>
<tr>
<td>Following low creatinine</td>
<td align="left">37.1%</td>
<td>13</td>
</tr>
<tr>
<td>Following suspected drinking</td>
<td align="left">62.9%</td>
<td>22</td>
</tr>
<tr>
<td>Randomly (indicate approximate frequency below)</td>
<td align="left">22.9%</td>
<td>8</td>
</tr>
<tr>
<td>Other reasons (please specify below)</td>
<td align="left">20.0%</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td align="left">Our program uses PEth testing in the following ways (Choose all that apply):</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td align="left">--------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td align="left">quarterly</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td align="left">We have used PEth test when results are ETG/ETS results are positive, but low and a report to the Board must be made. Because Peth is expensive, not all vacations are followed by a PEth. Some professionals are tested with urine tests randomly, but also PEth tests at times selected by the case manager.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td align="left">We are positioned to use PEth testing but have not yet had a situation that required us to do so.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td align="left">We do Peth testing on a quarterly basis for alcohol dependency. More frequently if recommended by the facility.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td align="left">For some who don't practice clinical medicine and who travel a lot we use PethStat every 3-4 weeks on a schedule and on several in addition to urine because of prior relapses.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td align="left">Only one PEth test b/c of several dilute test results</td>
<td></td>
</tr>
<tr>
<td></td>
<td align="left"></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td align="left">---</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td align="left">For some physicians, we test with PEth every 2 weeks.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td align="left">Reasonable suspicion or confirmation of history of drinking.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td align="left">We are just starting to use this test.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td align="left">PEth is less sensitive than EtS/EtG for low-level alcohol consumption and is used as such. While we have used as a confirmatory test when alcohol use is denied, a negative PEth does not mean the person was not drinking, just means they were not drinking moderately to heavily in the PEth window (~2 weeks)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td align="left">We had a board just approve PEth testing but have not yet started to use</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td align="left">We use on suspicion or with positive etg/ets if they do not admit instead of a full eval. especially on nondoctoral level participants</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td align="left">We will test if there are compliance issues, or if someone has a dilute screen (not just for low creatinine). We are doing one random test per year for alcohol dependent participants. We will test after vacations if there is reason for suspicion. We tell our participants that we MAY PEth test after vacations, and I believe this is a beneficial deterrent.</td>
<td></td>
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</tbody>
</table>
Direct metabolites of alcohol

**OXIDATIVE**

- Ethanol
  - alcohol dehydrogenase
  - MEOS
  - catalase
  - acetaldehyde dehydrogenase

**NON-OXIDATIVE**

- fatty acid
  - FAEE synthase
  - AEAT
  - ethyl glucuronide & ethyl sulfate

- phosphatidyl ethanol
  - phosphatidyl choline
  - phospholipase D

- ethyl esters

- acetate
Ethylglucurononide (EtG)

Formation

- via conjugation of ethanol with activated glucuronic acid in the presence of membrane bound mitochondrial UDP glucurononyl transferase (UGT)

*Stephan Seidl et al.*

Figure 1. Formation of ethyl glucurononide (EtG) by conjugation of UDP-glucuronic acid and ethanol.

Ethylglucuronide (EtG)

- Urine EtG (Immunoassay or LC/MS/MS)
  - Better than urine alcohol
  - False negatives – common w/ minimal alcohol use
  - False positives – from extraneous alcohol
    - Most common 3-6 hours after exposure
  - Slightly improved sensitivity and specificity w/ EtS
  - Can be used in combination with PEth (when drinking is denied)
Ethylglucuronide (EtG)

- An hour after alcohol consumption, EtG in urine will be positive
- Peaks at 3-4 hours
- Detectable up to 1-5 days after the complete elimination of alcohol from the body

(Schmitt et al., 1997, Wurst and Skipper, 1999, 2001; Seidl et al., 1998)
EtG levels daily x 4 days – alcohol detox unit
Single dose of alcohol, 1 oz vodka
Ethylglucuronide (EtG)

- Sensitivity of EtG (19 subjects, 1-6 drinks, all urine tests were negative after 26 hours)

Urine Ethylsulfate (EtS)

• When performed with EtG improves sensitivity and specificity
• Comparable cutoffs by LC/MS/MS?
  – 100 ng/mL / 25 ng/mL
  – 250 ng/mL / 50 ng/mL
  – 500 ng/mL / 100 ng/mL
  – 1000 ng/mL / 200 ng/mL
• Comparable window of detection
• Not confirmation of drinking!
Conclusion

• EtG/EtS are the best markers for early detection of drinking and for documenting abstinence but:
  – Probably miss most minor drinking episodes
  – Can be positive from recent extraneous exposure
Positive test

1. Confront the participant and offer as much support as possible if they “get honest” and admit drinking

2. If they deny drinking do one or more of the following:
   a. Provide information and warning re incidental exposure – and continue testing
   b. Order blood phosphatidyl ethanol and/or hair EtG
   c. Conduct further evaluation - possibly including polygraph (to induce honesty)
   d. Consider observed antabuse
   e. Photo-cellular Breathalyzer monitoring
SAMHSA Advisory (2012)

- A “high” positive (e.g., >1,000 ng/mL) may indicate:
  - Heavy drinking on the same day or previously (e.g., previous day or two).
  - Light drinking the same day.
- A “low” positive (e.g., 500–1,000 ng/mL) may indicate:
  - Previous heavy drinking (previous 1–3 days).
  - Recent light drinking (e.g., past 24 hours).
  - Recent intense “extraneous” exposure (within 24 hours or less).
- A “very low” positive (100–500 ng/mL) may indicate:
  - Previous heavy drinking (1–3 days).
  - Previous light drinking (12–36 hours).
  - Recent “extraneous” exposure.
Benefits of EtG testing

• Better to document abstinence (advocacy)
• Better than other markers for detecting recent alcohol use (early detection)
• Better to discourage drinking (deterrence)
• Better to R/O false positive urine alcohol (in-vitro fermentation) (confirmation)
• Useful in association with Soberlink or SCRAM (confirmation)
Phosphatidylethanolol

48 homologues
Phosphatidylethanol

• A direct biomarker that incorporates into cellular membranes.
• Takes much more alcohol to cause positive (≈8-14 drinks within 2 weeks) – more alcohol than possible from incidental or extraneous exposure
• Longer detection window - not metabolized rather degraded (2+ week duration) – half-life 4.4 days
• Once in red cell membrane - stays there until cells die
Combination Strategies

• Using PEth to confirm drinking following positive EtG/EtS when drinking denied
• Study: 18 positive EtGs

<table>
<thead>
<tr>
<th>Finding</th>
<th>#</th>
<th>%</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admitted drinking after positive EtG/EtS</td>
<td>8</td>
<td>44</td>
<td>Drinking</td>
</tr>
<tr>
<td>Admitted drinking after PEth explained</td>
<td>3</td>
<td>17</td>
<td>Drinking</td>
</tr>
<tr>
<td>Admitted drinking after positive PEth</td>
<td>1</td>
<td>6</td>
<td>Drinking</td>
</tr>
<tr>
<td>Denied drinking after positive PEth</td>
<td>1</td>
<td>6</td>
<td>Drinking</td>
</tr>
<tr>
<td>Denied drinking - negative PEth</td>
<td>5</td>
<td>28</td>
<td>Not Drinking</td>
</tr>
</tbody>
</table>
## New Alcohol Monitoring Devices

<table>
<thead>
<tr>
<th>Device</th>
<th>Approximate Date Introduced</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEMS – 3000</td>
<td>1995</td>
<td>Intermittent</td>
</tr>
<tr>
<td>In-Hom</td>
<td>2005</td>
<td>Intermittent</td>
</tr>
<tr>
<td>Soberlink</td>
<td>2008</td>
<td>Intermittent</td>
</tr>
<tr>
<td>SCRAM</td>
<td>2005</td>
<td>“Continuous”</td>
</tr>
</tbody>
</table>
Intermittent Transcutaneous Alcohol Monitoring
Positive ID Home Breathalyzers or Cellular Photo Digital Breathalyzer
MEMS 3000 is an efficient monitoring unit, integrating highly accurate breath alcohol testing (BAT), video identity verification and radio frequency (RF) presence monitoring in a single home unit.

MEMS 3000 monitoring application is offered either on a stand-alone, on-site host for independent data ownership and management or through secure remote hosting and Internet access.

**Simple to use**

MEMS 3000 transfers the breath alcohol test results and participant’s image to a monitoring center at the push of a button.

MEMS 3000 requires minimal training of both agency staff and program participants.
Smart Start In-Hom
Soberlink

Photo Identification:
Assures the identity of the user.
Facial recognition software.

Fuel Cell Sensor:
Provides highly accurate and reliable results.

DIMENSIONS:
Product Height: 4.75" (121mm)
Product Width: 1.5" (38mm)
Product Depth: 2.875" (73mm)

WEIGHT:
Product Weight: 6oz (190g)

WARRANTY:
1 Year Limited Warranty
Soberlink

- Test validation
  - Facial recognition software
  - Sends photo and breath alcohol to website
  - Emails monitor if non-zero breath alcohol or face appears different than control
Monitoring Web Portal

- Case manager receives **real-time results** and reviews on password protected web portal.

- Automated **text reminders** can be set up by case manager to remind participant when it’s time to test.

- **Real-time alerts** are sent to case manager for missed tests and positive BAC results.
Pilot Study Comparing 4 x Daily Photo Cellular Breathalyzer v Random Weekly EtG

- 12 subjects – social drinkers
- Kept log of drinking x 5 weeks, blew in Soberlink 4 times daily, submitted random weekly urine EtG, completed questionnaire
- 84 drinking episodes
- 55 EtGs collected of possible 60
- 1609 breath tests of possible 1680
Results

• Only 1 positive EtG
• Photo Cellular Breathalyzer detected all 84 drinking episodes (100%)
• Subjects all preferred using PCB to submitting urine tests
  – “It’s much easier to take 30 seconds 4 times per day than to drive to a collection site and wait sometimes ½ hour to submit a urine sample.”
  – “Much more convenient to blow in the Soberlink from home than to go to a collection site.”
  – “Embarrassing to submit a urine. Easy to blow in Soberlink device.”
  – “Much prefer blowing in Soberlink device.”
  – “No comparison. Prefer blowing instead of peeing.”
  – “More trouble to drive somewhere and wait to give urine sample.”
Who is using Soberlink

• ~500 professionals currently monitoring with Soberlink devices - ~150 health professionals using Soberlink for daily testing in 15 PHPs + ~200 airline pilots from American, United and JetBlue Airlines + ~150 professionals using Soberlink in “private monitoring”

• ~150 executives/professionals using Soberlink via “private monitoring” programs: professionalmonitoring.com (Katie Skipper), O’Connor Professional Group, Dr. Sucher, Recovery 360, etc.
Summary

Devices

• SCRAM
  – Primarily used by criminal justice system
  – Proven accuracy

• Soberlink
  – Effective
  – Can be used multiple times per day
  – Real time detection
Jane Doe asks:
I am on parole and I didn’t drink but they tell me my urine EtG was 3229ng/ml. I use Purrell all day every day. I’m going to be sent back to jail. This is unfair. Can you help me?
Common Questions

Jane Doe’s lab report shows:

Urine EtG = 3229ng/ml
Urine Creat = 10mg/dl
Common Questions

Surgeon in monitoring program has urine EtG of 350ng/ml and urine creatinine of 50mg/dl. Blood Peth was 62ng/ml. He says he accidentally drank a glass of punch with alcohol in it at a wedding.
Common Questions

Urine EtG = negative
Urine EtS = 125ng/ml
Common Questions

Urine EtG = 825ng/ml
Urine EtS = negative
Common Questions

Urine EtG = negative
Urine EtS = negative

Peth = 125ng/ml
Common Questions

Urine EtG = 256ng/ml
Urine EtS = negative

Peth = 125ng/ml
Hair EtG = 40pg/mg

(Hair EtG >2 is positive >30 suggests heavy drinking)
Question

• Text message received that participant just blew a positive breath alcohol at .09 and a follow-up 15 min later of .08
• Phoned participant who denied drinking and denied blowing in Soberlink device
Will these stand up in court?

• Criminal
• Civil
• Administrative
• Family
Daubert Standard

• The *Daubert standard* provides a *rule of evidence* regarding the admissibility of *expert witnesses' testimony*

• Pursuant to this standard, a party may raise a *Daubert motion*, which is a special case of *motion in limine* raised before or during *trial* to exclude the presentation of unqualified *evidence* to the *jury*
Daubert Trilogy

- The **Daubert trilogy** refers to the three United States Supreme Court cases that articulated the Daubert standard:
  - **Daubert v. Merrell Dow Pharmaceuticals**, which held in 1993 that Rule 702 of the Federal Rules of Evidence did not incorporate the Frye "general acceptance" test as a basis for assessing the admissibility of scientific expert testimony, but that the rule incorporated a flexible reliability standard instead;
  - **General Electric Co. v. Joiner**, which held that a district court judge may exclude expert testimony when there are gaps between the evidence relied on by an expert and his conclusion, and that an abuse-of-discretion standard of review is the proper standard for appellate courts to use in reviewing a trial court's decision of whether it should admit expert testimony;
  - **Kumho Tire Co. v. Carmichael**, which held in 1999 that the judge's gatekeeping function identified in Daubert applies to all expert testimony, including that which is non-scientific.
Daubert guidelines for admitting scientific expert testimony:

- **Judge is gatekeeper:** Under Rule 702, the task of "gatekeeping" rests on the trial judge.
- **Relevance and reliability:** This requires the trial judge to ensure that the expert's testimony is "relevant to the task at hand" and that it rests "on a reliable foundation".
- **Scientific knowledge = scientific method/methodology:** A conclusion will qualify as scientific knowledge if the proponent can demonstrate that it is the product of sound "scientific methodology" derived from the scientific method.\[3\]
  - **Factors relevant:** The Court defined "scientific methodology" as the process of formulating hypotheses and then conducting experiments to prove or falsify the hypothesis that it considered relevant for establishing the "validity" of scientific testimony:
    - Empirical testing: whether the theory or technique is falsifiable, refutable, and/or testable.
    - Whether it has been subjected to peer review and publication.
    - The known or potential error rate.
    - The existence and maintenance of standards and controls concerning its operation.
    - The degree to which the theory and technique is generally accepted by a relevant scientific community.
Jurisdiction

• Although the Daubert standard is now the law in federal court and over half of the states, the *Frye standard* remains the law in some jurisdictions including California, Illinois, Maryland, New York, New Jersey, Pennsylvania, and Washington.
New Alcohol Markers and Devices

• Relevance and Reliability

• Scientific method
  • Empirical testing
  • Whether it has been subjected to peer review and publication.
  • The known or potential error rate.
  • The existence and maintenance of standards and controls concerning its operation.
  • The degree to which the theory and technique is generally accepted by a relevant scientific community.
Soberlink

- [www.soberlinkphp.com](http://www.soberlinkphp.com)
- 334-233-3552
- Free month trial and customer support offered by Soberlink