The Window of Detection When Using Fingernail Clippings For Drug Testing
By Joseph Jones, MS, NRCC-TC, Vice President Laboratory Operations

Fingernail, a keratinized protein like hair, is emerging as a popular specimen type for drug and alcohol testing. Using fingernail samples for toxicological analysis and pharmacokinetic studies has been around for decades. However, many people do not have as much experience interpreting the results as they do hair and urine and there is confusion of whether to use a clipping or scarpings. One of the most frequent questions to the laboratory concerns the window of detection. How far back does the fingernail test go? To answer this, we need to discuss the anatomy of the fingernail and how compounds are incorporated into the nail.

Nail is keratinized protein very similar to hair. It is porous and compounds become entrapped and bind within the structure. For this discussion, we need to know 4 anatomical features: the germinal matrix, the nail plate, the nail bed, and the free edge (Figure 1). The nail originates at the germinal matrix and grows outward toward the fingertip. The hardened material forming the nail plate grows across the nail bed, which is rich in capillary blood flow (this causes the pinkish color to your fingernails). As the nail grows in length, material is added from underneath such that the nail lengthens and thickeners, as it grows outward toward the fingertip. Once the nail plate erupts from the nail bed and extends past the end of the fingertip, the part that extends over the edge of the fingertip is called the free edge. The free edge is the piece that you clip when clipping your nails. The entire process takes up to 6 months depending on the health of the individual.

Compounds are incorporated into fingernail by four main routes. The first route of incorporation, just like hair, is environmental exposure. If someone is handling drug or around someone smoking drug, the drug gets on the nail and works its way into the pores and binds to the keratinized protein. The second route of incorporation is the sweat and oil of the skin surrounding the nail deposit drug and drug metabolite into the nail.

The third route of incorporation is the blood flow in the germinal matrix deposits drug and drug metabolite into the nail when it is formed. Lastly, drug and drug metabolite are deposited to the underside of the nail plate by the blood flow in the nail bed. These four very different routes of incorporation are superimposed on top of each other rendering a very complex drug history picture.

In conclusion, for fingernail clippings there is a potential for a detection window of up to 6 months. Just like hair and urine, a negative result is not proof of abstinence, just the lack of evidence. A positive fingernail result for most drugs may be explained by drug use at any point during the 6 months prior to the collection. Being that the clipping contains the entire drug history of the growth of the nail, a nail scraping is not necessary.

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**Ask The Toxicologist – What do The Following Results Really Mean?**

**Client Question:**

Dear USDTL,

Our program has been monitoring drivers with three or more convictions for DUI using a combination of PEth in USDTL BloodSpot™ and EtG in USDTL NailStat®.

One of our participants reports abstinence, but his test results suggest otherwise and can be seen in the Figure 2 and Figure 3.

**What do these numbers mean?**

**Figure 2**

<table>
<thead>
<tr>
<th>Time Line</th>
<th>Nail EtG Level</th>
<th>PEth Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>160 pg/mg</td>
<td>362 ng/ml</td>
</tr>
<tr>
<td>11 wks</td>
<td>31 pg/mg</td>
<td>0 ng/ml</td>
</tr>
<tr>
<td>18 wks</td>
<td>199 pg/mg</td>
<td>39 ng/ml</td>
</tr>
<tr>
<td>24 wks</td>
<td>63 pg/mg</td>
<td>33 ng/ml</td>
</tr>
</tbody>
</table>

**USDTL Toxicologist Answer:**

The detection time window for EtG in fingernail is approximately 3 months and the detection time window for PEth (Phosphatidylethanol) in blood spot is approximately 3 weeks. Neither test will pick up incidental ingestion or social drinking, only binge and heavy drinking. The baseline figures are elevated as expected from a participant that has been recently convicted of driving while impaired. It would be expected that this individual had engaged in binge and heavy drinking over the past several weeks and months prior to entering the program. The EtG and PEth results are consistent with this expectation.

From the time of the baseline test in mid-April to the second test in the first week of July (11 weeks), the EtG nail levels fell from 160 pg/mg to 31 pg/mg and the PEth dropped from 362 ng/mL to negative. The best explanation for this observation is that the donor has significantly reduced their drinking and were perhaps abstinent during this period. The EtG detected in the nail was most likely left over from drinking prior to joining the program.

However, in 18 weeks and 24 weeks after baseline testing, the EtG in fingernail and PEth in blood spot were detected again. This reflects new binghe and heavy drinking after the second test (July 07, 2012) and after the third test (August 24, 2012). There were 5 weeks between the third and fourth test. If the donor had been abstinent after the third test, the PEth would have been negative. These tests show that the donor relapsed to a steady behavior of binge and heavy drinking after the second test (July 07, 2012).

**Alcohol Reported as Primary Substance of Abuse in 62% of Veterans’ Treatment Admissions**

There were nearly 58,000 admissions of veterans to substance abuse treatment facilities in 2010, according to the most recent data from the Treatment Episode Data Set (TEDS). TEDS, a database of treatment admissions to primarily publicly-funded substance abuse treatment facilities, excludes admissions to Veteran Affairs (VA) facilities. Therefore, the veteran admissions in TEDS represent veterans who chose to seek substance abuse treatment in a non-VA facility.* While alcohol was most likely to be reported as the primary substance of abuse among veterans and nonveterans alike, veterans were much more likely than nonveterans to report marijuana (7% vs 15%) or heroin (8% vs. 16%) as their primary substance of abuse. No other substances besides alcohol were reported by more than 10% of veterans as a primary substance of abuse, suggesting that use prevention, intervention, and treatment programs for military personnel and veterans should focus their resources on alcohol.

**Admissions Reporting Benzodiazepine And Narcotic Pain Reliever Abuse at Treatment Entry**

- The number of substance abuse treatment admissions reporting both benzodiazepine and narcotic pain reliever abuse increased 569.7 percent from 5,032 admissions in 2000 to 33,701 admissions in 2010, while the number of all other admissions decreased by 9.6 percent during the same period.
- In the month prior to treatment admission, 57.1 percent of benzodiazepine and narcotic pain reliever combination admissions reported daily use of narcotic pain relievers and 45.5 percent reported daily use of benzodiazepines.
- Almost half (45.7 percent) of benzodiazepine and narcotic pain reliever combination admissions reported a cooccurring psychiatric disorder compared with slightly more than one quarter (27.8 percent) of other admissions.

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For the full article go to: [http://www.samhsa.gov/data/2k12/TEDS-064/ TEDS-Short-Report-064-Benzodiazepines-2012.htm](http://www.samhsa.gov/data/2k12/TEDS-064/ TEDS-Short-Report-064-Benzodiazepines-2012.htm)

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Primary Substance of Abuse

Alcohol

Cocaine

Marijuana

Heroin

Opiates

Methamphetamine

*It is possible that veterans receiving treatment from VA treatment facilities may have a different pattern of primary substances of abuse than those found in TEDS.

**Note: A veteran is defined by TEDS as a person 16 years or over who has served (even for a short time), but is not now serving on active duty in the US Army, Navy, Marine Corps, Coast Guard, or Commissioned Corps of the US Public Health Service or Air Force, and who served during World War II. Persons who served in the National Guard or Military Reserves are classified as veterans only if they were ever called or ordered to active duty, not counting the 4-6 months for initial training or yearly summer camps.

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SOURCES: Adapted by CESAR from Substance Abuse and Mental Health Data Archive (SAMHDA), online analysis of the concatenated (FY 2006-2010) Treatment Episode Data Set (TEDS), based on data received through 10/1/11, conducted 11/16/11. Available online at SAMHSA's Treatment Episode Data Set (TEDS) website at http://www.ncbi.nlm.nih.gov/pubmed/22551517

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