

Alcohol Testing

A Brief Introduction

There are a number of different testing options with which we can assess alcohol consumption - dependent on the situation and detection window needed. I've detailed a little information about the various options, and put together some prices for hypothetical situations as well.

Hair and Nail Testing (EtG and FAEE)

When a longer detection window needs to be examined, we would recommend a hair test. With head hair, we can test a 3 or 6 month period of consumption (dependent on hair length). As head hair grows at approximately 1cm per month, we'd need 6cm to perform a 6 month hair strand alcohol test.

Hair strand alcohol testing measures Ethyl Glucuronide (EtG), an ethanol metabolite that is produced upon consumption, and does not evaporate from the hair like ethanol itself. EtG is therefore a direct biomarker of alcohol consumption that is predominantly deposited in the hair through blood vessels. With EtG testing, we can even segment the hair into two, 3cm sections to get a clearer overview of the change in consumption pattern over the last 6 months.

When chemical treatment of hair is evident or suspected, we would additionally test for Fatty Acid Ethyl Esters (FAEEs) in conjunction with EtG, as this metabolite is less susceptible to depletion through treatment. If there is no suspicion or evidence of chemical treatment, FAEE testing is not necessary. If chemical treatment is extensive, we may recommend a matrix change to body hair or nails. FAEEs are deposited in the hair primarily through excretion from the sebaceous gland. Increased migration of the metabolite means that an FAEE test cannot incorporate segmentation.

Body hair and nails are made from the same primary component as head hair (keratin), and so the metabolites formed from alcohol are trapped within these matrices in the same way. However - the detection windows differ; fingernail testing covers up to 6 months, and body hair covers up to 8 months, depending on length and growth rate. We would only test for EtG in nails and body hair; FAEEs are not required and would in fact present an increased risk of contamination due to a prevalence of ethanol containing body products.

Summary of detection windows:

Head Hair: 3 or 6 months history

Body Hair: Up to 8 months history (toxicologist assesses and may reduce if clearly groomed)

Fingernails: Up to 6 months history

Toenails: Up to 12 months history

Traditional Blood Testing

As ethanol itself is metabolised and excreted quickly from the body, assessing alcohol consumption with a blood test relies on other markers indicative of consumption. Traditional tests include Liver Function Testing (**LFT**), Carbohydrate Deficient Transferrin (**CDT**) Testing, and a Full Blood Count (**FBC**). Liver Function Testing assesses the levels of various proteins in the blood, either through their direct concentrations or their enzymatic activity - depending on the protein. Abnormal levels of these proteins are indicative of liver damage, which can be induced by excessive alcohol consumption. Elevated levels of certain proteins, like ALT and AST, can be indicative of these proteins leaking from a damaged or inflamed liver into the blood stream, while a decrease in others, such as Albumin,



indicates impaired synthesis. The spectrum of results are analysed with a view to assess alcohol consumption.

Carbohydrate Deficient Transferrin (**CDT**) testing assesses the structure of a protein called transferrin - an iron transporter in the blood. These proteins undergo post-translational modifications, with the addition of carbohydrate (sugar) 'tails' after the protein has been synthesised. Transferrin proteins usually have 3-5 of these little tails, with a small proportion being deficient (having no or a lower number of carbohydrate side-chain modifications). Disruption of the addition process causes the levels of Carbohydrate Deficient Transferrin to increase, and can again be caused or contributed to by excessive alcohol consumption.

A Full Blood Count (**FBC**) assesses the concentrations of different types of blood cells (and some proteins), such as red and white blood cells, platelets, and other blood cells involved in immune system functioning. The FBC also includes the assessment of Mean Corpuscular Volume (**MCV**) - which is essentially a measure of the mean volume of red blood cells. As is the emerging pattern, all assessments should fall into a certain normal range, with excessive alcohol consumption being a potential contributing factor to abnormal levels.

PEth Blood Testing

The problem with these traditional tests is that, as you may have noticed, none of them are direct biomarkers of alcohol consumption. This means that while they measure changes in the body that *can* be affected by excessive alcohol consumption, these changes can have a multitude of other underlying contributing factors. Other factors include age, sex, gender, underlying genetic conditions, other communicable illnesses, general fitness - and even menstruation. We regard the accuracy of the Liver Function Test as being so low that we no longer offer it on its own (although we of course still have the capability to do so), as we don't believe the outcomes of important family cases - often involving children or allegations of abuse - can be based on a test with such low accuracy. When the tests are combined (ie LFT, CDT, and FBC), accuracy in distinguishing excessive alcohol consumption only increases to around 77%.

Phosphatidylethanol (**PEth**) testing, on the other hand, is a direct biomarker of alcohol consumption, can only be detected when alcohol has been consumed, and is directly correlated with the level of alcohol consumed. On a molecular level, ethanol 'looks' a little bit like water - so some enzymes in the body can mistakenly incorporate ethanol into the processes they'd usually use water molecules for - often with a far higher affinity. PEth is formed when ethanol is combined with phospholipid molecules and incorporated into the membranes of red blood cells. PEth testing is therefore an extremely accurate (>99%) and sensitive measure of alcohol consumption over the last 28 days. It can be used to determine abstinence and excessive consumption, as well as a range of categorisations in between (occasional or social). In terms of pricing, the difference between the full traditional blood test and PEth is fairly negligible (£140 vs £149 exclusive of VAT). To exemplify PEth's superiority, we've had a few interesting cases where we've performed all tests (LFT, CDT, FBC and PEth), where the traditional tests have given no indication of excessive consumption, but PEth has demonstrated high consumption. We've also had cases where the opposite is true: traditional tests have been indicative of excessive consumption, but PEth has demonstrated otherwise.

We've also found PEth testing to be a good tool for monitoring consumption over an extended period of time in place of potentially intrusive monitoring techniques - where there is also the opportunity for tampering. Our usual practice would be to arrange monthly PEth tests, and provide the results of each test as soon as they're ready. As PEth is so clear to understand, we'd usually release the results as they



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are each month, with a single Expert Witness Report at the end of the period to summarise all results and the pattern of change.