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Ideas and questions to help you challenge disputed hair strand evidence in court

Preliminary points to remember

1. **The science behind hair strand testing is sound**. The authorities establish that the *science* behind hair strand testing is sound (i.e. the scientific process, analysing the hair, etc). There is rarely a successful challenge to be mounted regarding samples being switched, instrumentation or quality control failures etc. (RE D).

2. **Albeit on a rare basis, some testing companies can get it wrong**. Human or clerical error has been identified in reported cases for providing inaccurate results. This is particularly the case where the company does not have its own laboratory or only provides a basic service. There have also been a few incidents where data has been manipulated.

    a. **X Local Authority v Trimega Laboratories & Ors [2013] EWCC 6 (Fam)** https://www.familylawweek.co.uk/judgments/x-local-authority-v-trimega-laboratories-ors-2013-ewcc-6-fam/#:~:text=Application%20for%20wasted%20costs%20orders%20against%20Trimega%20Laboratories%20Ltd%2C%20following,the%20time%20of%20the%20application **–** *clerical error led to change of care plan for adoption when a negative test for alcohol was wrongly recorded a positive*.

    b. **https://www.theguardian.com/politics/2017/nov/23/regulator-calls-for-better-scrutiny-of-drug-testing-in-family-courts ; and**

    https://www.theguardian.com/uk-news/2017/feb/19/manchester-lab-randox-drink-drug-tests-toxicology-may-have-been-manipulated

3. **This is expert opinion evidence:** the interpretation of what any drugs found in the hair means is a matter of opinion evidence. It is the expert's opinion on whether it relates to use or exposure. This is the more fruitful area of challenge. The questions to consider are:

    a. Has the expert factored in the full context of the case – i.e. the complete background of the client, their history, and the environment (home/partner/lifestyle/etc.)?
    b. Does the expert have all the information needed to draw a fair conclusion, based on the balance of probabilities? Without full consideration of (a) above, it would be unlikely they could reach a decision based on the balance of probabilities.

Areas for cross examination of expert

1. **Topic one – have best practice/procedures been followed?**

    a. What was the training and credentials of the sample collector?
    b. How was the sample collected?
    c. Did the sample collector wear gloves? Is there evidence of that?
    d. Was the sample taken in a place that was clean and sterile, free of possible contaminants?
    e. Is the chain of custody complete (usually it is, but worth checking). Were sample identification (such as barcoding) and tamper evidence seals used?
    f. Does the lab have UKAS accreditation?
    g. Does the company who carried out the test in question have their own laboratory or do they rely on a third party to carry out the analysis?

2. **Topic two – chain of evidence, hair segmentation and decontamination process**

a) Was the scalp collection site(s) photographed and the approximate length of residual hair on the scalp factored into the interpretation of the time profile of drug exposure?

b) How can we be certain that there was no cross contamination between samples of hair, knowing that the location of the sample on the head can be determinative in the findings?
c) Does the time period reported correspond to the hair tested?
d) Was the integrity of the hair shaft structure examined to establish its condition and likely porosity?
e) Was the condition of the hair shaft/strand factored into the interpretation?
f) Was the hair sample segmented prior to analysis in order to establish a temporal profile of drug exposure?
g) Was the drug and metabolite concentration profile across the hair sections analysed factored into the interpretation?
h) Were the metabolite to parent drug concentration ratios determined?
i) Was the potential impact on the metabolite to parent drug ratios of environmental factors, physiological factors and any cosmetic treatment of the hair incorporated into the interpretation?
j) What decontamination procedure was used to remove drugs associated with environmental exposure? Did this decontamination procedure follow the Society of Hair Testing (SoHT) guidelines to use multiple washes and a mixture of organic and aqueous solvents?
k) With respect to the decontamination, were the initial and final washes from the decontamination analysed to determine the level of contamination on the hair sample on receipt and to demonstrate this contamination had been effectively removed prior to the sample being extracted? Were the results from the analysis of the decontamination washes factored into the interpretation to help establish the likelihood of the drugs detected being the result of environmental exposure or ingestion?

Research papers relevant to this:

- The role of variations in growth rate and sample collection on interpreting results of segmental analyses of hair Marc A. LeBeau Madeline A. Montgomery, Jason D. Brewer Forensic Science International 210 (2011) 110–116 (relates to differing growth rates on the scalp and the amount of hair left on the scalp, even by experienced testers)

- External Contamination of Hair with Cocaine: Evaluation of External Cocaine Contamination and Development of Performance-Testing

Materials Journal of Analytical Toxicology, Vol. 30, October 2006 (relates to bze/cocaine ratios)

- Application of discriminant analysis to differentiate between incorporation of cocaine and its congeners into hair and contamination C. Hoelzle b,c,* , F. Scheuflera, M. Uhla, H. Sachsb, D. Thiemeb, Forensic Science International 176 (2008) 13–18 (demonstrates significant non-enzymatic formation of benzoylecgonine under relatively mild conditions due to hydrolysis of cocaine)

3. Topic three – how has the expert interpreted the results?

a) Cut-off levels: has the expert just applied a cut-off level to interpret results?

I. Did the testing company use a cut-off level in their report to interpret the results as use/non-use?
II. Was their interpretation based solely on whether the drug concentrations were above or below that cut-off value?
III. Did the company use cut-offs to omit any results they may have obtained?
IV. Has the company fulfilled their obligation to "fully and faithfully report all findings" and does this include the reporting of findings that fell below a cut-off level threshold?
V. Were there substances detected but not included in the report due to the application of a cut-off level?
VI. Given variances in the testing process can cause levels to be present above cut-off as a result of laboratory-dependent variables, was the measurement of uncertainty inherent in the analytical methodology factored into the interpretation?
VII. A cut-off level has been used to opine that use explains these results. The justification for this interpretation is "the levels are above cut-off". Cut-off levels do not take into account alternative sources of drugs or hair-

specific factors that increase or decrease drugs present in the hair. Since cut-off levels do not factor in these circumstances, or the expertise of the toxicologist, how does a level above cut-off indicate drug use?

VIII. The results describe the findings as negative or not detected and indicate this is a level that falls below the cut-off. Since cut-off levels only indicate chronic use (as described in your report), what is "chronic use" and were any results that fall below the cut-offs withheld from the court?

IX. Have you considered that variance in the testing process can cause levels to be present above cut-off due to these laboratory dependent variables? If so, why have cut-offs been applied that can withhold evidence from the court?

X. The results are quoted as being "low/medium/high". Does this indication only relate to results above cut-off? If so, and given that results above cut-offs indicate chronic use (as stated in your report), what is meant by low chronic use? Do these benchmarks take into account levels below cut-off levels? If not, how can these results be ascribed as "low" when all results lower have been omitted from this comparative analysis?

XI. Does the 2021 SoHT consensus suggest a cut-off level for the metabolite of cocaine? If not, why have these cut-offs been applied?

XII. Does the SoHT recommend a cut-off level for the level of substances in body hair samples? If not, why was one applied and what data/research has been used to justify this cut-off level?

Specifically, has hair colour bias been factored in?

I. Research shows that drugs such as cocaine and opiates can be found at 100x the level in those with darker hair colour. Why has the cut-off level which is applied to blonde/black hair been applied to the results of this individual with blonde/black hair when such a variance exists? Are there cut-off levels suggested for each hair colour? Why not?

II. Have the variants in drug incorporation within black and brown hair been factored in? if not, why not?

III. If a cut-off has been applied, no other factors have been factored into this interpretation. This removes all toxicological expertise. This begs the question: Why has an interpretation been made which does not consider this factor regarding my client?

Research relevant to application of cut-off levels/hair colour bias to use in cross examination:

- Critical analysis of forensic cut-offs and legal thresholds: A coherent approach to inference and decision A. Bidermann, F. Taroni. S.Bozza, M Augvurger CGC Aitken
- The incorporation of drugs into hair: relationship of hair color and melanin concentration to phencyclidine incorporation M H Slawson, D G Wilkins, D E Rollins J Anal Toxicol 1998 Oct 22.
- Rollins, D. (2004) Role of melanin in the Drug Incorporation into Hair Presentation, SOHT, Des Plaines, IL
- The effect of hair color on the incorporation of codeine into human hair. Rollins DE, Wilkins DG, Krueger GG, Augsburger MP, Mizuno A, O'Neal C, Borges CR, Slawson MH.J Anal Toxicol. 2003 Nov-Dec;27(8):545–51. doi: 10.1093/jat/27.8.545.
- Cooper, G.A., Kronstrand, R. and Kintz, P., 2012. Society of Hair Testing guidelines for drug testing in hair. Forensic science international, 218(1-3), pp. 20-24.

Levels of drugs in the hair being affected by hair colour:

- Scheidweiler, K.B., Cone, E.J., Moolchan, E.T. and Huestis, M.A., 2005. Dose related distribution of codeine, cocaine, and metabolites into human hair following controlled oral codeine and subcutaneous cocaine administration. Journal of Pharmacology and Experimental Therapeutics, 313(2), pp.909-915.
- Rollins, D. (2004) Role of melanin in the Drug Incorporation into Hair Presentation, SOHT, Des Plaines, IL.

Topic four – has the expert factored in any relevant forensic history?

I. Have you collected any relevant forensic history either from interviewing the person or from a detailed letter of instruction?
II. Have you considered the case-specific history in this case when interpreting the results, or have you just applied cut-offs?

III. Does the person use hair dyes, leave-in conditioners, hair straighteners, hair dryers, hair products containing alcohol, bleach, or any other hair products that may influence the outcome of the hair strand test?
IV. Is the person pregnant?
V. Does the person live with or share a bed with, or in any other way closely associate with someone who is a substance user?
VI. Does the person work in or frequent a space where drugs or alcohol are routinely consumed?
VII. Has the company considered the above factors in their reporting? If a cut-off has been applied, the company cannot consider these factors as cut-offs are "one-size fits all".
VIII. Was the integrity of the hair shaft structure examined to establish its condition and likely porosity?" and "Was the condition of the hair shaft factored into the interpretation?
IX. Was the hair inspected for dye lines and was the presence of dye lines factored into the interpretation?
X. How have the case-specific circumstances (previous drug use, influences applied to the hair, levels of passive exposure) been taken into account when interpreting the results? Given that a cut-off has been used to interpret the results, how could these considerations be factored in when cut-offs are prescriptive and do **not** take these into external factors into account?
XI. Since sweat contains high levels of drug metabolites (given that this sample is routinely tested in toxicology for these substances), why are the results not explained by sharing a bed with a drug user? Sharing a bed with a drug user would cause daily exposure to high levels of drugs and metabolites over the course of several hours where the hair is direct contact with these substances.
XII. What is the expertise of the person giving evidence or interpreting these results?
    - Are they analytic or clinical toxicologists? Are they toxicologists at all? (some hair strand testing companies produce neither).

Articles relevant for this:

- AEME production in cocaine positive hair after thermal hair treatment Nicholas Gambier, Jenny Warling, Nicolas Van Elsue, Michael Yegles Forensic Science International, 2019, Sept; 302:109894 *(establishes that hair straighteners produce AEME in hair when cocaine is present)*.

- The incorporation of dyes into hair as a model for drug binding Forensic Science international Volume 107, Issues 1–3 Pages 1-402 (10 January 2000)

Topic five – how has the expert worked out the time period covered by the hair sample/hair growth:

I. It is quoted that hair grows at 1 cm per month. Is this quoted due a rounded-down conversion between 1 inch per month to metric measurement since 1 inch has historically been quoted and continues to be quoted in the USA? Since 0.5 inch is converted to 1.2 cm per month, does this mean that the 6 cm hair sample only covers 5 months, 1 month less than the court-instructed profile? If so, why was this not accounted for in your testing and interpretation?
II. Do different ethnicities have different growth rates?
III. How are differing growth rates factored into your interpretation?
IV. If hair grows at a slower rate, does two months' worth of drug consumption appear a one-month sample? Does this artificially raise the conclusions about quantum of use?

Articles in relevant for this:

- African hair growth parameters, comparative study, BR J Dermatol 2001 Aug, 145 294-6 (https://pubmed.ncbi.nlm.nih.gov/11531795/) – *difference in growth rates for causation and African hair. Growth parameters studies mostly in Caucasian hair.*

Topic six: Nail testing

i. Is the nail consistent with hair strand results?
ii. Toe vs fingernail, contamination?
iii. If fingernail, has the individual been in an environment where they could have touched or been directly exposed to drugs?

Articles relevant to this:

- **Detection of Drugs in nails: three year experience *Journal of Analytical Toxicology*, Volume 39, Issue 8, October 2015, Pages 624–628, https://doi.org/10.1093/jat/bkv067**
  Published: 16 September 2015

Topic seven: Alcohol testing:

i. If EtPa can formed when alcohol is applied to the scalp, how can "positive" EtPa with "negative" EtG (a biomarker only formed when alcohol is ingested) demonstrate alcohol ingestion?
ii. Does the result being below the cut-off and reported as negative for EtG in fact demonstrate that excessive consumption has not occurred? Otherwise, does this not indicate that the cut-off level for EtG is incorrect? What was the level EtG detected (if any) which was below cut-off?

iii. PEth eliminates from the blood by 50% every 2 to 14 days. How has this elimination been factored into the interpretation of this result? Why is 220 ng/ml (for example) of PEth quoted as representing "excessive" when no cut-off has been suggested by an independent body? Can 250 ng/ml represent PEth which was 1,000 ng/ml being eliminated by the body over the course of 3 weeks abstention? If so, why is 220 ng/ml quoted as representing excessive alcohol consumption?

Articles relevant for this:

- Elimination Characteristics of the Alcohol Biomarker Phosphatidylethanol (PEth) in Blood during Alcohol Detoxification, Alcohol Alcohol, 2019 April 10;54 251-257 (*https://pmc.ncbi.nlm.nih.gov/articles/PMC7011165/*) – *different rates at which PEth is eliminated from the system. This indicates that it is possible to make only approximate estimate of the quantity and recently of alcohol intake base on a single PEth value.*

THC analysis:

- Were either of the THC metabolites, 11-Nor-9-carboxy-THC or 11-hydroxy-THC, quantified to establish the relative likelihood of ingestion over exposure?

Case law or studies to support your challenge:

Re D (Children: Interim Care Order: Hair Strand Testing) [2024] EWCA Civ 498 – *lead court of appeal decision, best place to start*

Re H (hair strand testing) [2017] EWFC 64 – *lead authority on this evidence being expert opinion evidence*

Haringey London Borough Council v Q and others [2023] EWFC 314 (B) – *case where hair testing successfully challenged with use of hair for same period in afro Carriben hair. Single issue case where child not adopted but placed with father following challenge*

Re K (a child) (death: failure to give evidence) A local authority v The mother and others (the maternal grandmother and another intervening) [2020] EWHC 2502 (Fam) – *exploration of different drug readings in case concerning death of child, both in respect of drugs present in hair of child and adults.*

London Borough of Barnet v T (Mother) and others (Alere Toxicology and others intervening) [2017] EWFC 64, [2017] 4 WLR 179, [2018] 1 FLR 762, [2018] Fam Law 25, 167 NLJ 7765, [2017] All ER (D) 48 (Oct)

London Borough of Islington v M and another [2017] EWHC 364 (Fam) (Hayden J) – *hair strand testing should never be regarded as determinative of conclusive*

E (A Child : Care proceedings : Costs) [2017] EWFC 118 (17 October 2017) – *Regarding **"Toxicology", paragraph 49-85**: "I propose to send this Judgment to the President of the Family Division for his attention regarding the toxicology issue as it is not my role as a Circuit Judge to provide guidance to toxicology companies generally."*

Bristol City Council v A Mother [2012] EWHC 2548 (Fam), [2013] 2 FLR 1153, [2012] All ER (D) 169 (Sep) – *another report case dealing with conflicting reports*

LA v M and others [2019] Lexis Citation 88 – *evidence given by different labs. Application of Re H.*

London Borough of Islington v M and another [2017] EWHC 364 (Fam) – *doubts as to veracity of hair strand testing raised. Use vs contamination.*

***D* (A Child) [2014] EWCA Civ 1149** – *successful challenge to hair strand test on basis that company not taken relevant factors into account i.e. thyroid condition that may have affected hair growth. Permission to appeal granted on this basis by CoA*

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