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# A practical model to explain results of comparative DNA testing in court

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With ongoing developments in forensic genetics (DNA-typing) more information is derived from minimal and partly degraded biological samples, but explaining this information to criminal justice professionals has become increasingly challenging. We developed a practical model to help forensic scientists explain and jurists understand the meaning of reported DNA-based evidence. Using this concept reporting officers classify results of comparative DNA testing, including complex low-template mixtures, in a uniform way. Application of this model to casework met with appreciation from jurists.

The model distinguishes four successive steps: (1) Analytical process: from crime stain to DNA profile, designation of the alleles; (2) Interpretation of the DNA typing results: defining the DNA profiles of the trace material; (3) DNA-profile comparison, determination of the evidential value of the results, and formulation of a conclusion at source level; (4) Evaluation of the findings of the forensic biological examination in the context of the other facts and circumstances in the criminal case, and formulation of a conclusion at activity level. After the alleles are assigned in step 1, the coherence of alleles is established in step 2: how many contributors are represented, can profiles be deduced, are there low-template contributors and is a consensus method based on replicate analyses appropriate? To prevent interpretation bias, step 3 does not take place until step 2 is completed. The results of comparative DNA testing are classified to one of four categories of scientific evidence: A: exclusion; B: match with standard statistical interpretation (random match probability, likelihood ratio method, probability of inclusion/exclusion); C: match without standard statistical interpretation; D: no exclusion or match, subdivided into subcategory D1: cannot be excluded and subcategory D2: inconclusive. A match is obtained (categories B and C) if it can be concluded that all the alleles of the reference profile are also present in the (in step 2) defined DNA profile of the evidence. In appropriate cases the evidential value of a category C and D result can be reported by using a verbal likelihood ratio statement as to the strength of the evidence, based on two mutually exclusive hypotheses at source level and statistical probabilistic interpretation models. Ultimately, in step 4 the criminal justice professional will evaluate the significance of the DNA-based evidence in the context of the other facts and circumstances in the criminal case. He may involve the forensic scientist by asking about the 'offence association' of the trace material and the DNA profile obtained from it. The forensic scientist will consider the findings from the forensic biological testing under two (or more) competing hypotheses at activity level, each of which could explain how the DNA was transferred. Where steps 1-3 concern source level (which individual does the biological material originate from), step 4 concerns activity level: what activity could have led to deposition of the material? In making a statement at activity level the forensic scientist refrains from giving any verdict on the probability of the hypotheses themselves; that is the domain of the court.

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