E38 Theoretical Evaluation of the Use of the Bloodstain Pooling Method as a Screening Technique

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After attending this presentation, attendees will understand the theory of the method which is used in sampling large numbers of bloodstains following blood-pattern analysis through pooling techniques as a screening method. The possible obstacles of this technique and its positive side will be discussed.

This presentation will impact the forensic science community by reviewing the method of using blood-pattern analysis in sampling bloodstains and the use of pooling techniques to check for the presence of stains from different contributors.

There is a continuous effort to make forensic testing more efficient and economical and to lower turn-around time and cost. This is especially important in cases that include large numbers of bloodstains being submitted for testing. Differentiating, sampling, and identification of different contributors of bloodstains are important for more accurate crime scene reconstruction and to identify the suspect or other persons related to the case.

Large numbers of bloodstains can be encountered in a multitude of crime scene-related areas such as clothes, different surfaces, tools, and the human body. The Scientific Working Group on Bloodstain Pattern Analysis (SWGSTAIN) identified multiple types of stain patterns which can be detected including altered drop, projected pattern, satellite stain, splash stain, swipe stain, transfer stain, swipe pattern, bubble ring, cast-off pattern, drip (stain, pattern, and trail), flow pattern, impact pattern, insect stain, and cessation cast-off patterns. Similar and different blood patterns from the same or different persons can be found either at the crime scene or on the collected evidence. Blood patterns can be used to differentiate between possible sources, but may be less helpful when the information about the case circumstances are limited or incorrect, making sampling based on Bloodstain Pattern Analysis (BPA) less effective.

Reliability of BPA was examined by a United States Department of Justice report which indicated that contextual information can affect the analysts' conclusions, which is a confirmatory bias.[1] This could show the need for a more quantitative method to be followed in the sampling decision.

The challenges reported by different experts in examining large numbers of bloodstains include the time-consuming nature of such sampling for DNA, when there is less reliability on BPA. To solve this issue, there is a need for a stain-screening method to check for the presence of a mixture or a single profile.

The pooling samples technique, suggested by Dorfman in 1943, is a known method in genetics and chemistry which examines members of a large population based on group testing theory.[2] It was Dorfman's proposed pooling for blood samples of groups of men inducted into the military service that tested the combined blood samples for antigens to identify the presence of syphilis.[3] Currently, this method is used in biological testing, such as mutation detection.[4] Forensically, based on this method, groups of bloodstain are pooled and tested for mixture profile.

When required, stains are classified into groups, either on the basis of the blood pattern(s) or of their location. Each group of samples is taken using either a wet swab or by excising a small piece of the material. Each group of samples is then pooled together for DNA analysis. In the case of the pool showing a single profile, there will be no future testing. The samples number in one pool will increase if there is a higher possibility of a single contributor, but the samples number will decrease in cases where there is a higher possibility of more than one contributor. If the pool of a group indicates a mixed profile, each stain in the group will be further assisted and resampled individually to locate the bloodstain which may have caused the mixture.

The advantages of this method include less testing required, the ability to screen large numbers of bloodstains, quicker results, less manual effort, reduced cost, and quicker location of different contributor's bloodstains. The use of the pooling method has several challenges including pool group size, equivalent quantity of DNA from each bloodstain, degradation of some mixed bloodstains (missing profile), and masked allele by major profile. The conditions which can affect using the pooling technique include the sample quantity, contamination issues, stain size, stain location, case requirements, number of contributors, unknown suspects, laboratory budget, laboratory quality procedures, case strategy, and results retention time. More research is needed to evaluate this method forensically.

References:

1. Laber T, Kish P, Taylor M, Owens G, Osborne N, Curran J. Reliability Assessment of Current Methods in Bloodstain Pattern Analysis. U.S. Department of Justice, National Institute of Justice; 2014 June. Report No.: 247180.
2. Dorfman R. The Detection of Defective Members of Large Populations. *The Annals of Mathematical Statistics*. 1943: 14 (4):436-440.
3. Lendle SD, Hudgens MG, and Qaqish BF. Group Testing for Case Identification with Correlated Responses. Biometrics. 2012:68(2): 532–540.
4. Amos CI, Frazier ML, Wang W. DNA Pooling in Mutation Detection with Reference to Sequence Analysis. *Am. J. Hum. Genet*. 2000:66:1689–1692.

Bloodstains, Blood Pattern Analysis, Pooling Technique