B115 Investigator-Mediated DNA Transfer

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Learning Overview: After attending this presentation, attendees will better understand the challenges in assessing alleged contact DNA transfer events and complex DNA mixtures.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating how the high sensitivity of current forensic DNA technology enables the detection of an individual's DNA on an object they never directly contacted, which has the potential to produce falsely incriminating evidence.

Ongoing improvements in forensic DNA analysis technology allow increasingly small amounts of DNA to be detected. This had led to increased success in obtaining results from low template samples; however, research to evaluate the risks of passive DNA transfer has not progressed with the advances in technology. Because bias creates a tendency to associate a crime scene profile with direct evidence of criminal activity, there are significant risks in the lack of understanding of DNA transfer.

The purpose of this study was to explore the possibility of investigator-mediated transfer of contact DNA, based on a homicide case in which the defense raised this theory to question the presence of the suspect's DNA on the murder weapon. The officers at the crime scene reported that the coroner had handled a Lululemon bag, possibly containing the suspect's DNA, followed by the handgun he discovered on top of the bag, without changing gloves. The experimental design of this study modeled this alleged tertiary DNA transfer chain, from the Lululemon bag, to nitrile gloves, to a gun, following the procedure used by Fonnelop, Egeland, and Gill.[1] This was done having zero, one, two, and three individuals handling the gun prior to the transfer procedure, in order to examine the effect of background DNA.

DNA was extracted by the organic extraction and microfiltration method. The samples were quantified using the Quantifiler® Trio kit before amplification using the GlobalFiler® kit, with capillary electrophoresis performed using a 3500 Genetic Analyzer. DNA profiles that indicated the presence of a mixture were analyzed in STRmix™.

A shedder test was first conducted as per Goray et al. in order to estimate the shedder abilities of the four participants in the study.[2] One participant was selected based on their good shedder classification to act as the primary donor, or "suspect." The other three participants were classified as poor shedders, who deposited partial DNA profiles. One appeared to be a very poor shedder, who deposited more of another individual's DNA than their own.

In the first DNA transfer experiment, a full primary donor DNA profile was found on the gun in two out of three replicates, despite the fact that the primary donor never held the gun. A full DNA profile was found on the bag and glove in all three replicates. A repeated measures Analysis of Variance (ANOVA) with sphericity assumed determined that the mean DNA concentration was significantly different between the three substrates ($F[2, 4]=10.022$, $p=0.028$). Mauchly's test, $\chi^2(2)=5.341$, $p=0.069$, did not indicate any violation of sphericity.

When one individual had handled the gun prior to the transfer of the primary donor's DNA, near full primary donor DNA profiles were found on the gun. There was very strong support for the inclusion of the primary donor's DNA in the mixture. In one sample, the DNA profiling results are 41 trillion times more likely if they had originated from the primary donor and three unknown individuals than if they had originated from four unknown individuals. Where two and three individuals, respectively, handled the gun prior to transfer, the primary donor's DNA was not readily resolvable from the mixture. The primary donor was excluded as a contributor in most three-person mixtures, but likelihood ratios provided limited support for their inclusion in four-person mixtures. Notably, there was support for the exclusion of the very poor shedder from the mixture, despite them directly handling the gun.

These results suggest that there is currently a paradoxical relationship between the expanded forensic DNA technological capabilities and the level of confidence that can be placed on the nature or origin of contact DNA samples and the inclusion of minor contributors in a complex mixture. This study provides evidence that low template contact DNA evidence should be interpreted with caution.

Reference(s):

1. Fonneløp, Ane Elida, Thore Egeland, and Peter Gill. Secondary and Subsequent DNA Transfer during Criminal Investigation. *Forensic Science International: Genetics* 17, (2015): 155-162.
2. Goray, M., S. Fowler, B. Szkuta, and R.A. van Oorschot. Shedder status—An Analysis of Self and Non-Self DNA in Multiple Handprints Deposited by the Same Individuals Over Time. *Forensic Science International: Genetics* 23, (2016): 190-196.

DNA Transfer, Contact DNA, Complex Mixtures

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