



### **E22 DNA in the Air: The Recovery of DNA Samples From Residential HVAC Air Return Filters Using the Single 4N6FLOQSwab™ Method**

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After attending this presentation, attendees will be familiar with collecting DNA samples from residential Heating, Ventilation, and Air Conditioning (HVAC) air return filters and the potential of using such samples to aid in forensic investigations.

This presentation will impact the forensic science community by demonstrating that the single-swab method is effective in collecting DNA samples from residential HVAC air return filters. It explores this source of biological material as an indicator of living habits and evaluates the cumulative deposition of ambient DNA within the household.

The recovery of DNA samples from various surfaces and objects is of significant value to forensic investigations. The forensic science community has engaged in vibrant discussions and medicolegal debates over topics pertaining to “touch” DNA evidence, such as the modes of DNA transference from person to person, person to object, and vice versa. This important debate continues in the backdrop of heavier reliance on DNA data with varying degrees of complexity and, sometimes, the dangerously creative interpretation thereof. When it comes to explaining “touch” DNA evidence in particular, the foundational understanding of what is reasonable (and what is not) must be reconciled with the simple fact that DNA is all around us. Humans are constantly shedding skin cells — thousands of them every day. Although a proportion of dead skin cells will have lost nuclear DNA content in the process of keratinization, some will still contribute nuclear, as well as extra-nuclear (free) DNA template sufficient for typing. Recent research has demonstrated that common house dust contains an appreciable amount of the occupant’s DNA. This study evaluates whether the common house dust that is captured by HVAC air return filters will yield useful DNA profile data (e.g., missing person searches) and whether any observable differences exist in the representation of DNA profiles from multiple occupants in different vents distributed around a dwelling.

A three-story single-family home (basement, ground level, and second floor) was volunteered as the sample collection site. Built in and continuously occupied since 1999, the current four occupants (one male and three females) have lived in this home on a regular and continuous basis for the past four years. The home is serviced by two independent HVAC systems: HVAC #1 circulates air between the first floor (zone 1, fitted with two ceiling-mounted air return vents) and the basement (zone 2, fitted with one wall-mounted air return vent). HVAC #2 circulates air on the second floor only (zone 3, fitted with four air return vents). A set of seven HVAC filters (Filtrete® Basic, 3M®), one from each vent, was sampled after being in service for 15 days. A section measuring 5cm x 2cm on the inflow surface of each filter was swabbed for DNA using the COPAN® crime scene 4N6FLOQSwabs™ that were pre-wetted with 15uL of sterile water (single-swab method). The samples were extracted using the COPAN® Nucleic Acids Optimizers (NAO), a semi-permeable basket that retains fluid until centrifuged with the PrepFiler® Express™ on the AutoMate Express™ DNA Extraction. DNA was quantitated using the Quantifiler® Human DNA Quantification Kit. The AmpFℓSTR® Identifiler® Plus Polymerase Chain Reaction (PCR) Amplification Kit was used for DNA amplification. The amplified fragments were separated on the Applied Biosystems® 3130 Genetic Analyzer. Data analysis was performed with GeneMapper® ID-X v1.4.

Useful DNA profiles were obtained from all seven vents. Samples from wall-mounted vents revealed slightly higher DNA quantities than ceiling vents with the one exception of the zone 3 vent positioned above the work desk of one of the female occupants. Although zone 2 (basement) is the least occupied space in the house, the associated filter revealed more dust and the highest DNA quantitation value (0.037ng/ul) among all samples, possibly due to that vent being closest to the HVAC unit and drawing a larger parcel of circulating air in comparison. The allelic data reveal consistencies with dwelling/sleeping arrangements, whereas common areas show mixture profiles originating from all four occupants. No foreign alleles were detectable.

#### **Residential HVAC DNA, Touch DNA, Air Filter DNA**