PICK & MIX-TURES

Decoding forensic stains with RNA

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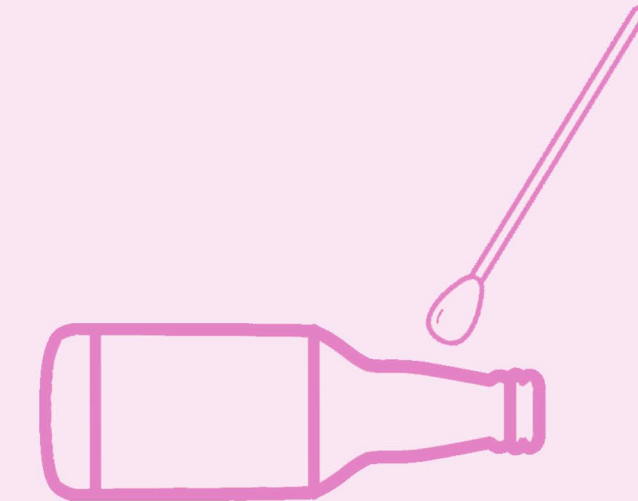
supervised by Douglas Elliot[a,b] and Rachel Fleming[b]

WHY IS THIS IMPORTANT?

Identifying the type of body fluid present in stains is commonly used on forensic evidence associated with sexual assault cases. **Body fluid identification can give context to DNA profiles, and assist with crime reconstruction.** Currently used methods for body fluid identification suffer from a range of limitations, such as false positive results for other body fluids/non-human body fluids, and an inability to detect vaginal material and menstrual fluid[1]. Many forensic stains are mixtures of more than one body fluid.

HOW DID WE DO IT?

DNA is converted to RNA in cells depending on the needs of the cell. **Different types of RNA can be used as body fluid markers[2].** We developed a test which detects one specific RNA marker per body fluid of interest. We created 18 mock mixtures of body fluids on swabs. RNA was extracted from each swab, which was amplified and detected using real-time polymerase chain reaction. This uses fluorescently labelled probes which target the RNA markers, and amplifies them if present, which is monitored in real-time.

1

Creation of mock mixtures, e.g. small volume of semen on a vaginal swab

2

RNA extraction, amplification and detection of the body fluid markers

3

- ⊗ Saliva
- ⊗ Blood
- ⊗ Menstrual
- ✓ Semen
- ✓ Vaginal

For each sample, the presence or absence of body fluids is confirmed

We developed an RNA-based confirmatory method to identify mixed and highly dilute body fluids, which is sometimes required for forensic testing of sexual assault evidence. Our approach is more informative than screening tests, and more efficient and sensitive than the confirmatory testing currently available.
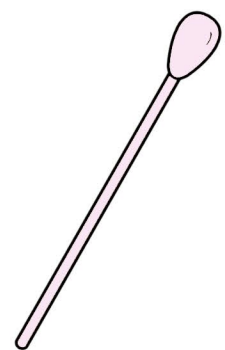
CASE EXAMPLE

A complainant alleges she was sexually assaulted with a beer bottle. A swab of the neck of the bottle gives a DNA profile that matches the complainant. The defence assert the DNA is from the complainant's saliva when she drank from the bottle. We cannot confirm the presence of vaginal material with just the DNA profile and conventional testing for body fluid identification. **Providing this information is possible with RNA.**
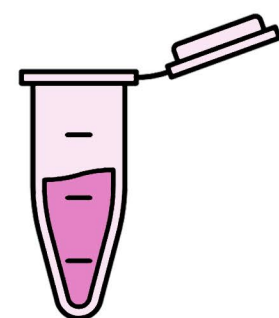
WHAT DID WE FIND?

Across the 18 mixtures, **98% of markers expected were detected.** This included the detection of 50 nanolitres of semen on a vaginal swab (the equivalent of 5×10^{-5} mL). For 16 of the 18 mixtures all body fluids expected were detected, and no unexpected markers were observed. This technique may be used to identify body fluids present on exhibits from sexual assaults. **In some cases, this would be information we would not be able to obtain from standard testing.**

REFERENCES

1. Roeder A, and Haas C. mRNA profiling using a minimum of five mRNA markers per body fluid and a novel scoring method for body fluid identification. International Journal of Legal Medicine. 2013
2. Bauer M, Kraus A, Patzelt D. Detection of epithelial cells in dried blood stains by reverse transcriptase-polymerase chain reaction. Journal of Forensic Science. 1999

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