# MIMICKING TRANSFER AND PERSISTENCE OF TRACE DNA
## Contamination Pathway Illumination

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## Contamination

- The unintentional, or undesirable, transfer of something onto or into, a scene, a person or an item of interest in a criminal investigation.

## Why is it important?

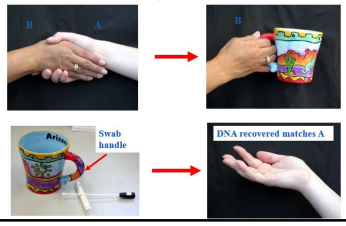
- Increased sensitivity of DNA profiling techniques means contamination can more easily be detected
  - Makes interpretation of DNA results difficult
  - May raise issues around the integrity of evidence
- Injustice for complainant's
- Miscarriage's of justice
- Loss of irreplaceable samples
- Poor customer service

"What part of 'secure the crime scene' don't you understand?!!!"

## Every contact leaves a trace…

2 main forms of transfer

- Direct transfer – primary transfer
- Indirect transfer – Secondary, tertiary transfer etc.



MYTHBUSTERS

- Can someone with a runny nose spread there snot to you?
- Dinner party (30 mins)
- Host has mechanical running nose with UV liquid to simulate nasal secretions
  - 60ml/hr
- 6 guests
  - 3 guests told to behave as germaphobes
  - 3 guests unaware
- Host uses a handkerchief to wipe nose

Source: https://www.youtube.com/watch?v=k18bh8_0_0

## UV markers to illuminate transfer

Benefits include:

- Cost effective
- Easily visualised
- Instant results during and/or after experiments
- Action relevant
- Can highlight surface areas and examination equipment prone to contamination accumulation
- Can identify areas of deficiency in procedures and anti-contamination procedures
- Realistic transfer

## UV Fluorescent Markers

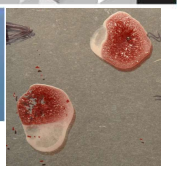
- Liquid (Green)
  - White acrylic ink
  - Median particle size of 4µm
  - Excitation peak at 310nm
  - Non-toxic
- Powder (Red)
  - White powder
  - Median particle size of 5µm
  - Excitation peak at 360nm
  - Non-toxic
- Powder very difficult to contain and measure out therefore not used

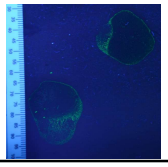

## Spiking Biological Fluids with UV Markers

- Blood, semen and saliva
- Establish the minimum volume of UV marker to add to each biological fluid
  - Obtain maximum fluorescence
  - Minimise dilution
  - Maintain the physical properties of the biological fluid
- UV marker added to 1ml of each biological fluids at 1µL increments until fluorescence plateaued

## Blood

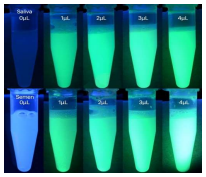
- Difficulties in finding optimal ratio of fluorescent marker to blood
  - Fluorescence only just visible when10µL of marker added.
  - Did not appear to dissolve uniformly in blood
  - Separated out? – pellet
- Fluorescence masked once the blood had dried





## Saliva and Semen

- Optimal ratio of 4µL of UV marker to 1mL of body fluid for both semen and saliva was established
- Stock solution of 10mL made for each body fluid type and refrigerated
- Does the UV marker effect the biological fluids?



## Effect of liquid fluorescent marker on fluid

- Aliquot of each semen and saliva stock solution quantified
  - Semen 26.4ng/µL
  - Saliva 0.19ng/µL
- Does the addition of the fluorescent marker affect the enzyme activity of the biological fluids?
  - AP and Phadebas tests performed on 50µL aliquots of a dilution series of each stock solution on a glass surface

| Dilution | Saliva | | | Semen | | |
|---|---|---|---|---|---|---|
| | Fluorescence Wet | Fluorescence Dry | Phadebas Test | Fluorescence Wet | Fluorescence Dry | AP Test |
| 1/10 | V | V | 40m | V | V | 4s |
| 1/100 | V | V | >40m | V | V | 9s |
| 1/1000 | V | V | - | V | V | Weak 20s |
| 1/10,000 | - | - | - | V | - | - |
| 1/100,000 | - | - | - | - | - | - |

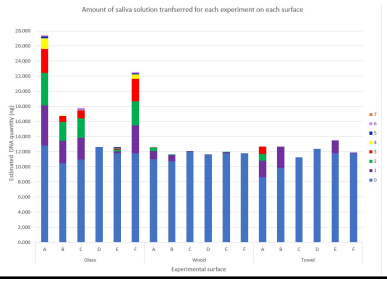
Key: V = visible, # = positive after time

## Cleaning Experiment

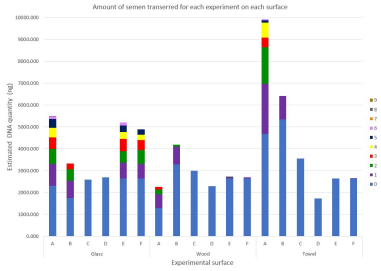
## Transfer Experiments

- 3 surface types tested
  - Glass
  - Wood – sanded finish
  - Towel
- 6 experiments
  - A – wet parent stain transferred continuously by a single gloved finger
  - B – wet parent stain transferred using a new glove per transfer
  - C – Same as A but parent stain dry
  - D – Same as B but parent stain dry
  - E – Same as C but parent stain re-wet with 100µL of water
  - F – Same as C but gloved finger wet with 100µL
- Attempt to quantify transfer based on intensity of fluorescence using ImageJ software

## Results




## Results




## Future studies


- Establish a trace DNA simulant? Powder?
- Incorporate the spiked body fluids into bio-screening competency tests to assess lab hygiene practices in addition to their bio-screening ability?
- Test effectiveness of PPE and establish the best order to gown and de-gown to avoid transfer of operator DNA to PPE during the gowning process and transfer of examination residues to operator during de-gowning
- Validate estimations regarding amount of DNA transfer based on the UV intensity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