

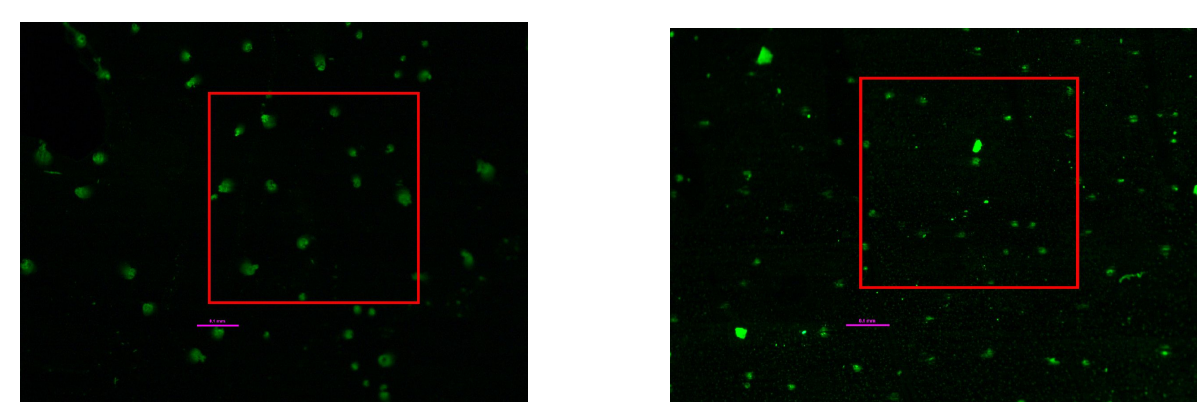
Introduction

- Contact traces are an important part of DNA casework in all crime laboratories, but the probative value of trace DNA often hinges on the possibility of passive transfer.
- Differences in shedding propensity - (the variation of how much DNA an individual leaves behind when touching an item) - is a major factor for passive DNA transfer (1).
- A published method for testing shedder status through cell counts found consistent levels of cell deposits after repeated sampling (2).
- This study used the same DNA staining/cell counting method established by (2) to test for shedder variation and reproducibility of repeated collections.

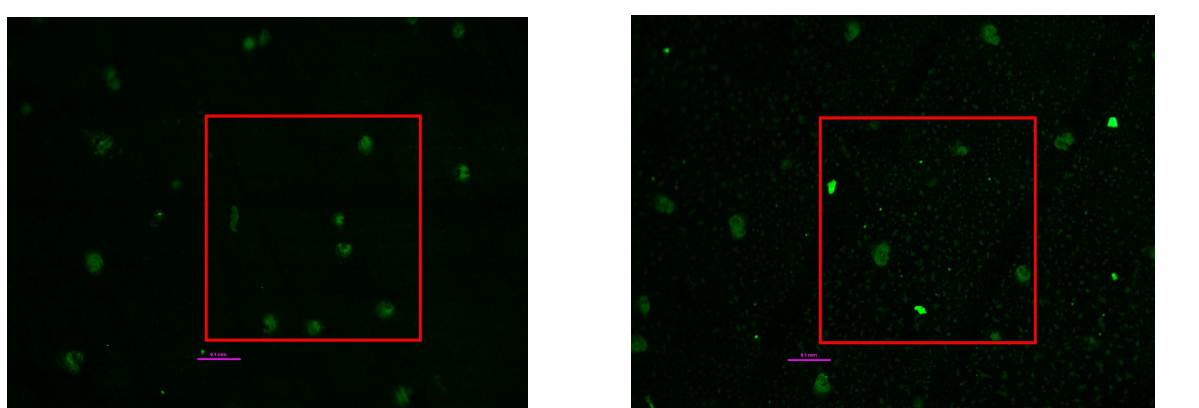
Research Questions

1. How much shedding propensity variation is there between donors?
2. Does handwashing affect cell count and shedder status?
3. How consistent are repeated collections?
4. Is there a difference between male and female fingerprint donors?
5. Can we distinguish between different types of shedding propensity (high, intermediate, low)?

Microscopy



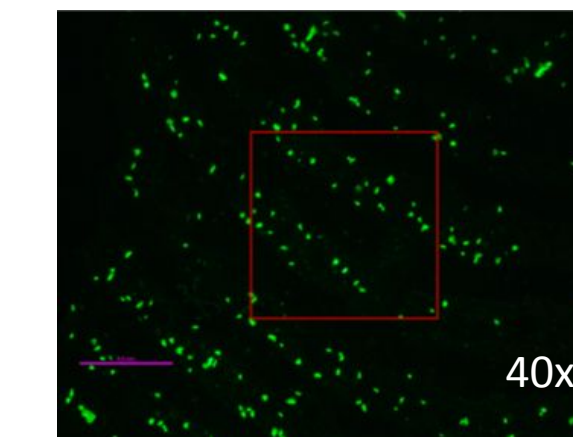
Images A and B show the fluorescence for a "high" shedder for washed and unwashed prints at x100 magnification.



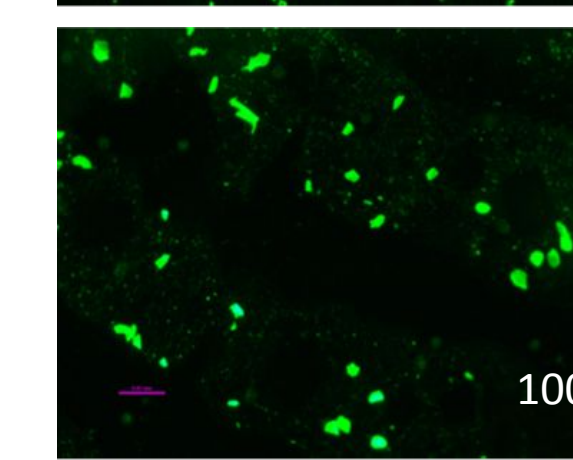
Images C and C show the fluorescence for a "low" shedder for washed and unwashed prints at x100 magnification.

Material and Methods

- Samples were collected from 26 donors, which included 14 males and 12 females. Volunteers were asked to deposit a print of their left middle finger on a clean glass slide, then wash their hands and after waiting for 30 minutes while not touching anything, deposit a print of their right middle finger. This collection was done for 3 consecutive weeks, 6 prints from each individual, 156 prints in total.
- Prints were stained with 20x Diamond Dye (Promega, Madison, WI) and read at the Fluorescein iso-thiocyanate (FITC) filter setting (495nm excitation and 550nm emission) on a Nikon Eclipse E600 fluorescent microscope. Signal counts were done at 100x magnification for three different 0.5x0.5mm squares for each print and averaged.
- Statistical analysis was performed after two outliers with abnormally high cell counts were removed, using data for 11 female and 13 male donors and a combination of statistical tests for regular and log transformed data with either R or Excel.



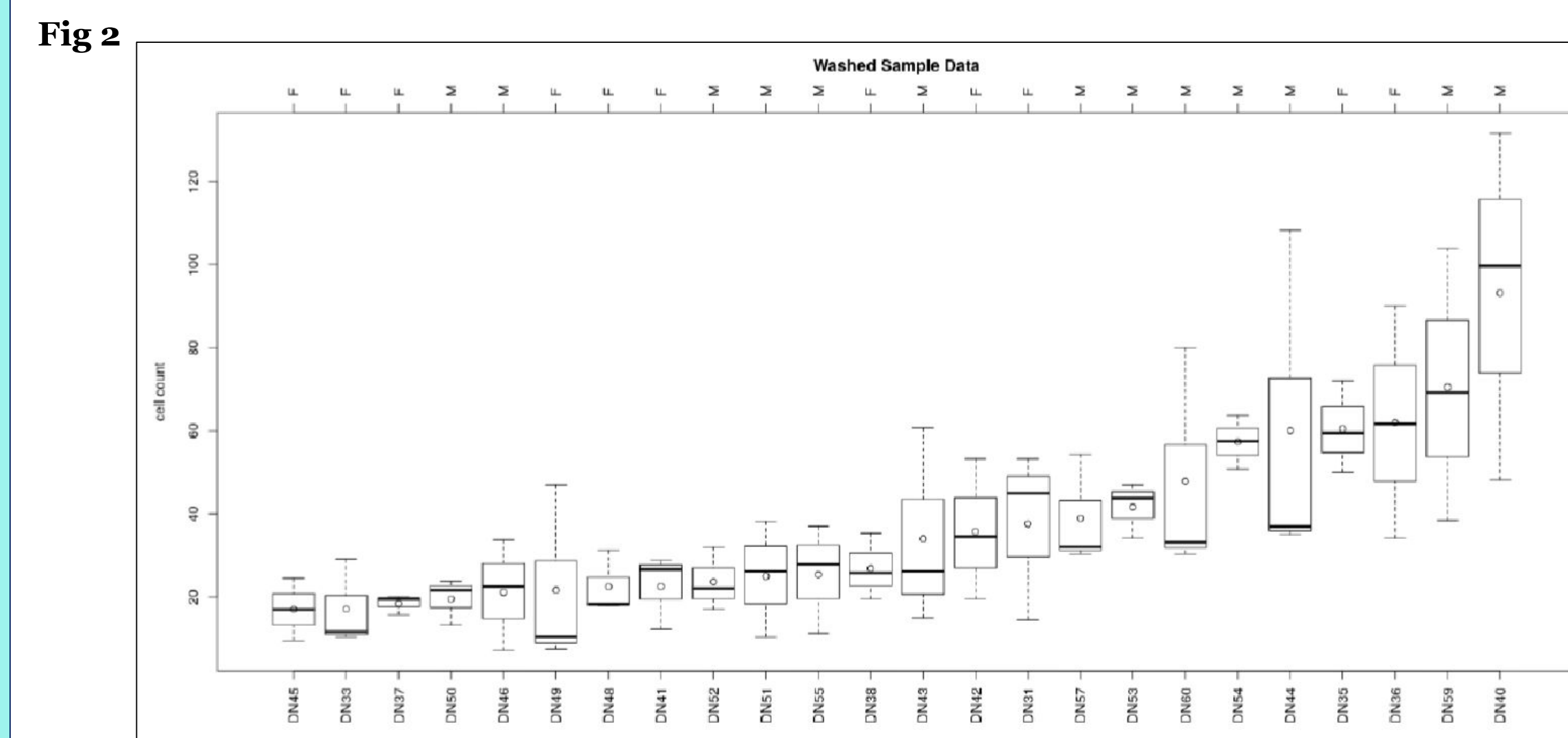
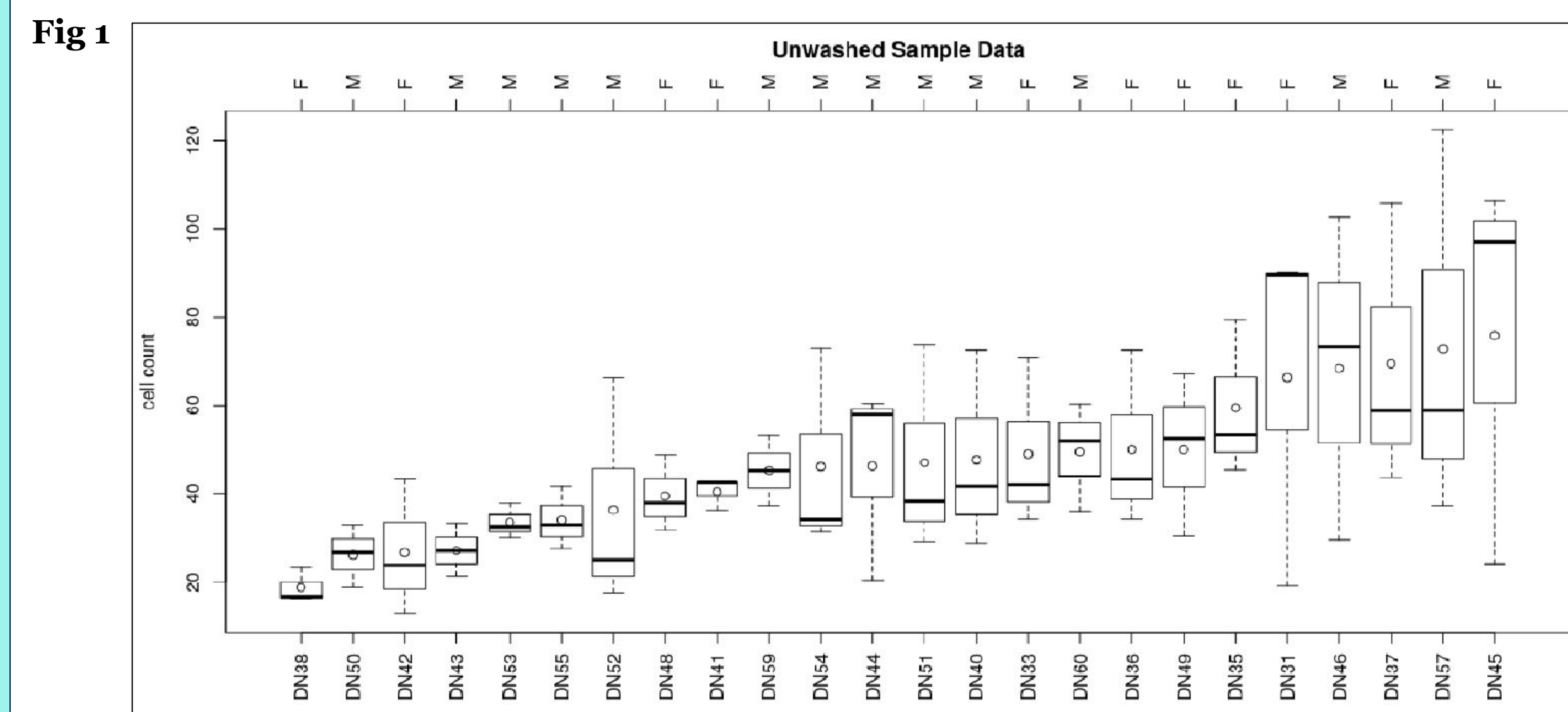
The images show Diamond Dye stained prints for the same donor at two different magnifications.



Friction ridge detail is visible at 40x, counts were performed at 100x.

Results

How much variation is there between donors and can we distinguish different types of shedders?



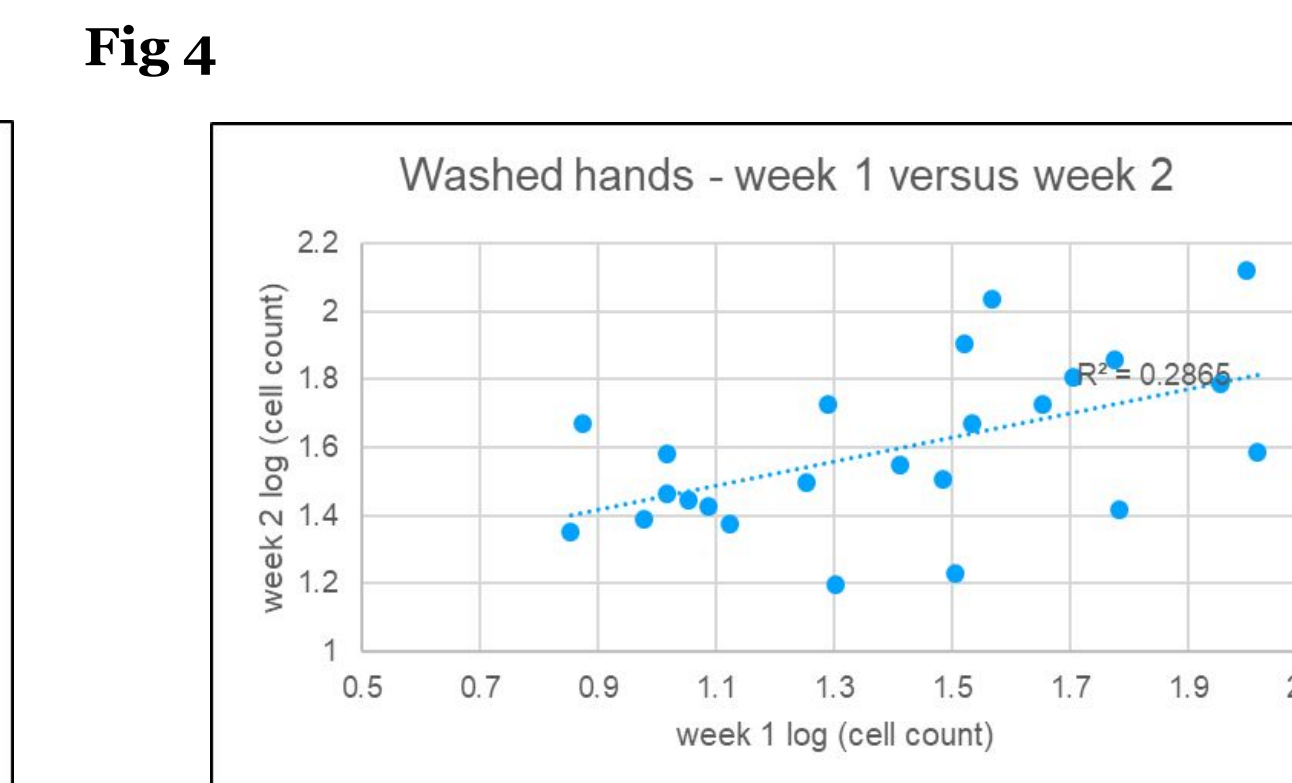
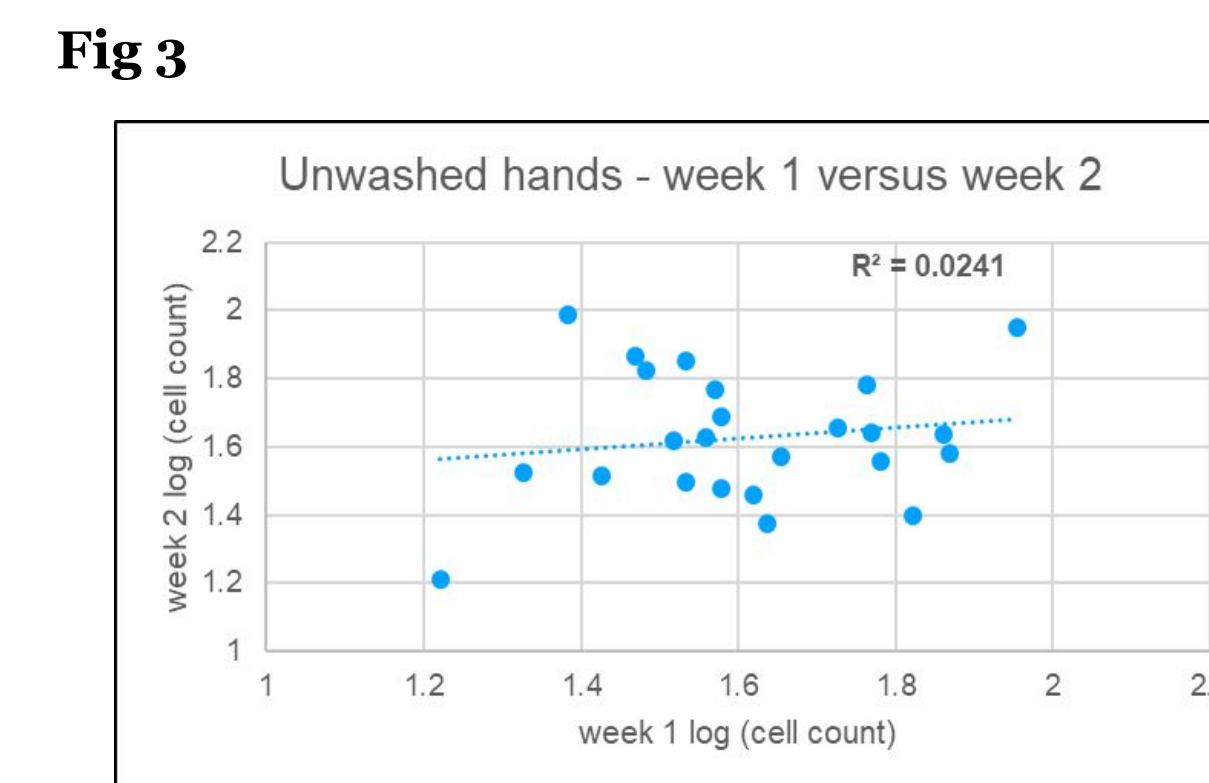
Figures 1 and 2 show differences in mean cell counts between individual donors and the large range for the three collections for most samples. The distribution is continuous from low to high cell counts, with no obvious break points.

Variance testing showed that for unwashed hands donor to donor variability is low when compared to the daily variation for the individual donors. For washed hands donors show more differences to each other, but there is still a large variance in the day-to-day collections.

Classical one-way random effects model for unwashed data:			
Source of Variation	Variance	SD	Portion of Variation (%)
donor-to-donor	0.04	0.20	14.8
daily	0.22	0.47	85.2

Classical one-way random effects model for washed data:			
Source of Variation	Variance	SD	Portion of Variation (%)
donor-to-donor	0.18	0.42	39.7
daily	0.27	0.52	60.3

How consistent are repeated collections for either the unwashed or washed hands?



Figures 3 and 4 show examples of scatter plots for pairs of collection days.

There was no correlation between the three collections for unwashed hands. Only washed hand show R values greater 0.4 confirming a correlation between cell deposits for different collection events for the donor sets.

Washed Hands	R ²	R
Week 1 versus 2	0.29	0.54
Week 1 versus 3	0.26	0.51
Week 2 versus 3	0.16	0.41

Do handwashing and biological gender affect cell counts and shedder status?

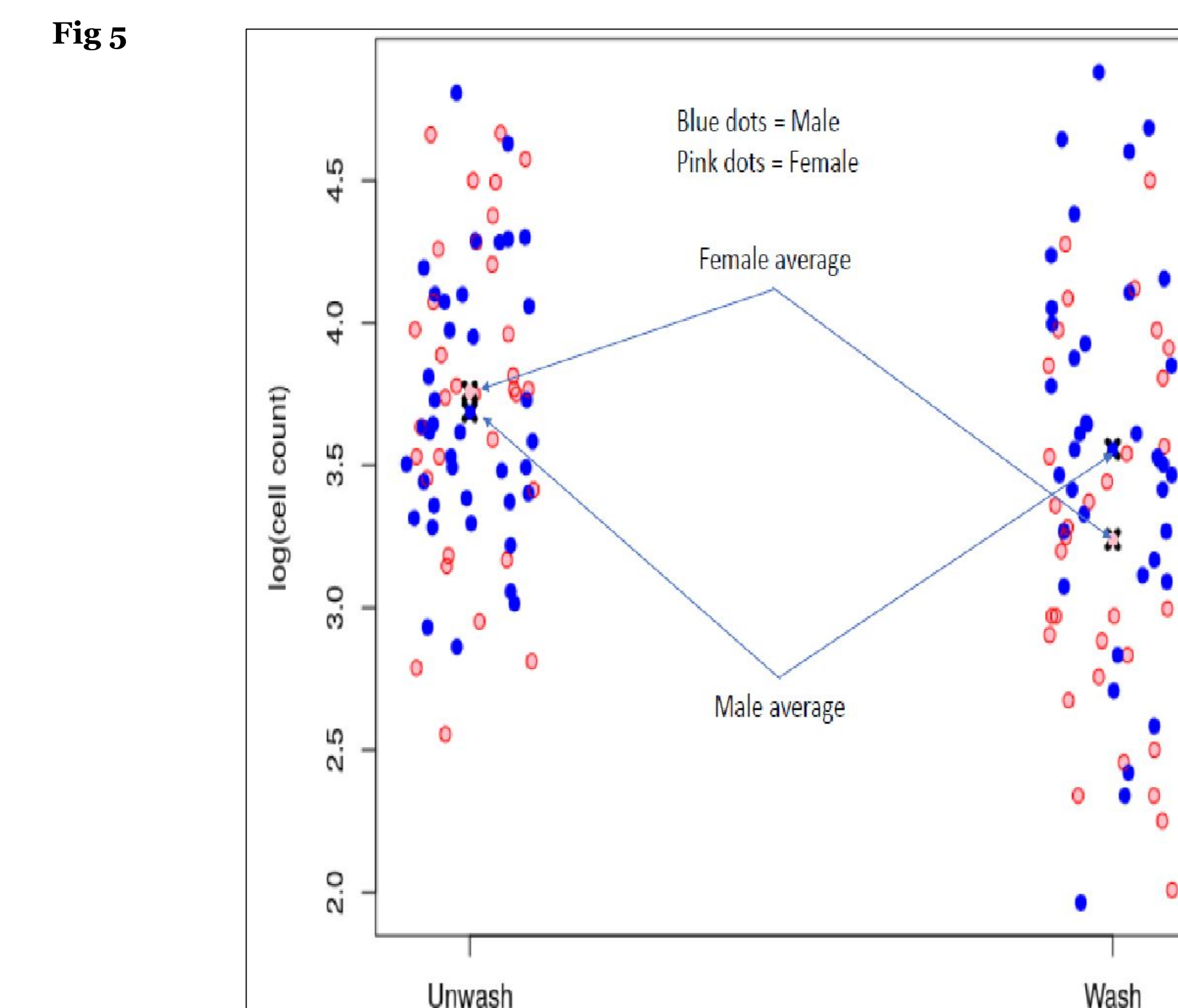


Figure 5 shows all cell count logs by wash status and gender. For females the mean is higher in unwashed samples and lower post hand washing, which is different from males.

Conclusions

1. There is a wide range in cell count variation from very low to high values, confirming that some individuals' leave more DNA behind and have a higher risk for passive transfer.
2. As expected, cell counts for washed hands were lower than for unwashed hands; this difference was significant .
3. Repeated collections varied for unwashed fingers. For washed fingers cell counts are more consistent, indicating the amount of cells/DNA in a fingerprint is a biological trait. Individuals whose washed samples were high for one week remained consistently high for the other collections.
4. There is no statistical correlation between gender and shedder status. The average cell counts for male and female were not significantly different.
5. Washed fingers constitute a better representation of biological shedder status, but the difference between low and high counts was continuous. More research is needed to distinguish shedding propensity categories.

Results continued

Do handwashing and biological gender affect cell counts and shedder status?

Two way fixed effect testing for the results shown in **Figure 5** showed a significant difference between unwashed and washed hands (p=0.1).

We did not detect a significant difference in cell counts based on gender (p=0.97), which is in accordance to a study based 146 fingerprints where no gender difference was seen (3).

Averages and standard deviations	
Overall average unwashed	46.86 ± 24.56
Overall average washed	37.50 ± 25.73
Female average unwashed	49.53 ± 26.44
Female average washed	31.06 ± 20.16
Male average unwashed	44.60 ± 22.96
Male average washed	42.94 ± 28.78

References

1. Szkuta B. et al. Transfer and persistence of DNA on the hands and the influence of activities performed. *Forensic Sci Int Genet.* 2017;28:10–20.
2. Kanokwongnuwut P. et al. Shedding light on shedders. *Forensic Sci Int Genet.* 2018;36:20–5
3. Manoli, P. et al. Sex-specific age association with primary DNA transfer. *Int. J. Legal Med.* **130**, 103–112 (2016).

Reproducibility of individual DNA Deposits detected with Diamond Dye

Presented by Natalee Small-Davidson

POSTER FACT SHEET

- Individuals leave DNA behind when they come in contact with a surface, according to Locard's Exchange Principle. Locard's exchange principle states that, in the physical world, whenever perpetrators enter or leave a crime scene, they will leave something behind and take something with them. Examples include DNA, latent prints, hair, and fibers.
- For trace DNA that is deposited by touching this transfer can be either active (the individual is at the crime scene and comes in contact with the surface) or passive (the DNA was present on somebody's hands or an object that came in contact with the surface).
- Differences in shedding propensity - (the variation of how much DNA an individual leaves behind when touching an item) - is a major factor for passive DNA transfer. High shedders are more likely to have their DNA present on an object that could cause passive transfer.
- This study focuses on determining an individual's shedding propensity, by looking at deliberate fingerprints. With the use of a specialized nucleic acid dye (Diamond) by Promega, latent prints can be visualized under a fluorescent microscope to view DNA deposits.
- 28 individuals were asked submit fingerprints, over a course of 3 weeks. Fingerprints were from washed and unwashed fingers and male and female donors.

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